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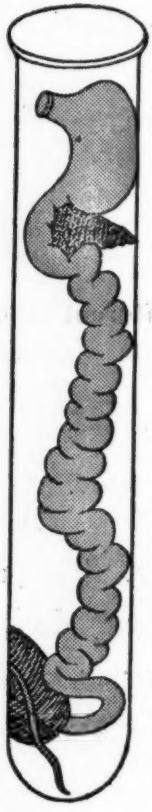

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Current Science

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INDIAN MEDICINE

INTEREST in the indigenous system of medicine—Ayurvedic, Unani and Tibbi—has been roused for the past 100 years or more. The revival of this system has been engaging the attention of experts, enthusiasts and the Government for some time now. As early as 1845, Dr. T. A. Wise drew the attention of the Western World to the merits of the ancient Hindu system of medicines. Later on, at the Medical Congress held in Calcutta during 1894, interest in this subject was revived. The Government of India also appointed a Committee to go into the question of the desirability of extending the use of Indigenous Drugs in India and recommend ways and means of popularising this system.

As a result, study in the indigenous system of medicine was started at the School of Tropical Medicine, Calcutta, by Col. Sir R. N. Chopra and also at the Haffkine Institute at Bombay. A modest beginning was made at Calcutta in 1921 and it was not till 1926, when the Indian Research Fund Association gave a grant, that investigations were taken up in right earnest. Very little encouragement was, however, forthcoming from the Government as then constituted on account of the vested interest in the allopathic system. The interest of the Government was therefore confined only to the exploitation of the indigenous drugs for the benefit of the foreign pharmaceutical cencerns. But in spite of the lack of encouragement, the investigations into the rationale of the indigenous system of medicine at the School of Tropical Medicine and at Haffkine Institute, were appreciated more and more. During recent years, Mysore, Travancore, Madras and Banares have taken a prominent part to revive the glory and usefulness of the indigenous system. Recently (1947) the National Government of India has appointed the Chopra Committee to recommend steps to promote research in the indigenous medicine. The Committee have gone round the country, collecting evidence from individuals and exponents of this system and their report is eagerly awaited.

The ancient Hindu system made considerable progress in the science of medicine and this is fully acknowledged by the

savants who have studied both the Western and Eastern systems. The efficacy of any system is best proved by the cures they effect and the large number of Ayurvedic and Unani physicians practising bears testimony to the value of these systems.

Nevertheless, our knowledge of ancient Hindu medical system at present, is limited. Indian medicine of an earlier period ("Charaka" and "Susruta" 800-700 B.C.) was, however, not only cognisant of the Hippocratic doctrine regarding many drugs and diseases but was also developed through keen observation, induction and deduction—a sound basis for pharmacy and therapeutics. Probably it will be a surprise to many when they discover the amount of anatomical knowledge which is contained in the works of the earliest medical writers in India. No satisfactory knowledge of human anatomy can be attained without recourse to dissection and we have direct proof of such practice in the medical compendium of "Susruta" and it is indirectly confirmed by the statement of "Charaka".

The literature extant on the ancient system bears testimony to the fact that practice of both medicine and surgery had attained its zenith of development. A close study of the literature of ancient period reveals the extent of scientific knowledge regarding diagnosis and treatment of diseases then prevalent. "Susruta" devotes two chapters (the seventh and eighth of the Sutra Sthana) to the discription of surgical instruments and one chapter (the twenty-fifth) to the principles of surgical operations.

Time has now arrived to acknowledge the merits of the ancient system in the light of the latest knowledge in medical and allied sciences.

The indigenous systems of medicine minister to the needs of 80 per cent. of the population of India at the present time, particularly in the rural area. The popular view is therefore, that this system should not be excluded from the field of medicine. Chopra (Indigenous Drugs Enquiry — a review of the work—July 1939) has pointed out that it should be used to the best advantage while the rationalisation of the system is being worked out. The rationalisation should consist of the evolution of a country-wide extension of the system which can be regarded in the words of the Bhore Committee "neither as Eastern nor Western but is a corpus of scientific knowledge and practice belonging to the whole world in which every country has made its contribution"

Anything which is valuable in any system has to be pooled and placed at the services of suffering humanity. India can ill-afford to run diverse systems of medicine, side by side, and we have to evolve a system of medicine, based on rational lines. Col. Chopra, who has spent his life-time on this subject, has very clearly brought out the role of indigenous medicine and its synthesis with modern system in his Presidential Address at the 35th Indian Science Congress. What the Indian systems could indeed adopt is the scientific approach to the problem—from the empirical knowledge of a crude drug to its use as a rational scientific medicine. It must pass through (1) botanical identification of the medicinal plants, (2) a thorough chemical examination of their active ingredients, (3) pharmacological and toxicological investigation and finally (4) clinical trial. The indigenous systems must seek rational explanation for all physiological and pathological phenomena. Additional knowledge of anatomy, physiology and pathology would certainly provide a better understanding of the theory and practice of the indigenous system and would inculcate in the practitioners an essential scientific outlook.

Evidence has been placed before the Chopra Committee emphasising the need for comprehensive research on the indigenous system. It is hoped that the proposed Central Drugs Research Institute will ensure the fullest collaboration between all the allied sciences concerned in drug research. An Indian Pharmacopœia should be prepared, the object of which should be to select drugs whose medicinal properties have been established and to prepare suitable compositions of the drugs for the best advantage. Such a scientific pharmacopœia should consist of all the useful knowledge of Ayurvedic, Unani and Allopathic systems. This would automatically remove the barriers that now exist between the different systems. We are confident that the Chopra Committee will give their earnest consideration to these and many other problems connected with the subject and lay the foundation for the revival of the Indian system of medicine, so that its future will be even brighter than its past.

MODE OF ACTION OF VITAMIN D—A RESUMÉ

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THE discovery of vitamin D as the specific etiological agent in rickets was an event of great significance to the science of nutrition. It led to intensive investigations on the occurrence, properties, isolation and preparation of vitamin D in the pure state. At the same time the physiological function of vitamin D and prevention and treatment of rickets were being studied by different groups of workers. After nearly thirty years of work, more than ten substances with varying vitamin D activity have been discovered, of these vitamin D_2 and D_3 are the most important. Although much valuable information on the biological side has been added during the same period, vitamin D is one of the few known vitamins about the mode of action of which there is very little definite knowledge.

Cod-liver oil had been in use for medical purposes[1] since 1789; its use for rickets was first reported in 1824. It was in 1909, however, that any indications of the mode of its action became available when Schabad[2] reported his classical experiments on the effects of cod-liver oil on calcium and phosphorus metabolism in rickets. In 1919 Mellanby[3] found that cod-liver oil was effective in curing rickets experimentally produced in puppies. McCollum[4] and others (1921) demonstrated the curative action of the oil in rat rickets; from the same laboratory came the first proof of the presence of a fat-soluble vitamin in cod-liver oil in addition to vitamin A discovered earlier.

The observation of Huldschinsky[5] (1919) on the therapeutic effect of ultra-violet rays in infantile rickets started another series of researches in a number of laboratories culminating in the isolation of calciferol in pure form in 1932 by Askew *et al.*[6] and Windaus[7] *et al.* with an activity of 40,000 I. U. per mgm. of the crystalline material. Calciferol or vitamin D_2 is a product obtained on irradiation of ergosterol. Soon it was proved that calciferol was not the naturally occurring vitamin D found in the liver oils or the one generated in the skin by the action of ultra-violet rays. An irradiated product of 7-dehydrocholesterol was identified as the natural vitamin (Bills,[8] 1938) and is now known as vitamin D_3 having an antirachitic activity for rats comparable with that of calciferol.

The progress in the knowledge about the mechanism of action of vitamin D did not, however, keep pace with that on the chemical side. Only two definite results have emerged thus far as a result of intensive studies carried out by numerous workers. The first is that in therapeutic doses, vitamin D promotes retention of calcium and phosphorus, particularly in rachitic animals and the second, that vitamin D, also in therapeutic doses, cures rickets by permitting calcification of the bone to proceed in a normal manner. An adequate supply of vitamin D to the young animal can prevent the onset of rickets. These manifestations however, are the end results of vitamin D action. They do not throw much light on how the action is brought about. Certain hypotheses have been put forward to explain the action. They are not entirely satisfactory but are currently accepted for want of more convincing explanation. It is therefore the aim of this article to review in brief the evidence for and against these hypotheses with a view to indicating further lines of attack which may possibly lead to a better understanding of the mode of action of vitamin D. So much work on the subject has been published that it would be impossible to deal with all of it in this article. An attempt has therefore been made to cite some of the more important references which have largely contributed to the present state of our knowledge regarding vitamin D.

As mentioned earlier, Schabad was the first to demonstrate that in rachitic infants, the administration of cod-liver oil increased the retention of calcium and phosphorus. Findlay, Paton and Sharpe[9] (1920-22) suggested that the increased loss of calcium through the fæces was due to the fact that calcium was not properly utilised in the body of the rachitic children and hence was re-excreted in the digestive tract. Telfer[10] (1922-23) and Orr, Holt, Wilkins and Boone[11] (1923-24) also observed diminished retention of calcium and phosphorus in clinical rickets. Further metabolic studies by Telfer[12] (1926) using cod-liver oil and of Hottinger[13] (1929) using irradiated ergosterol brought out the fact that under the influence of vitamin D there was a shift from fæces to urine in the excretion of calcium and phosphorus. Watchorn[14] (1930) reported a decrease in the fæcal calcium and phosphorus of rachitic rats after administration of irradiated ergosterol. A reduction in calcium excreted with the fæces of rachitic rats administered irradiated ergosterol was also observed by Kern, Montgomery and Still[15] (1931) and Harris and Innes[16] (1931). Such observations inevitably pointed to the conclusion that vitamin D favoured the absorption of calcium and/or phosphorus from the gut. It must be pointed out that these conclusions were based on studies in which the sum of calcium and phosphorus elimination in urine and fæces was compared with the intake of these elements. Such balance studies are expected to yield correct information only when there is no re-excretion in the gut of the substances absorbed from the upper reaches of the small intestine. When such is not the case, the interpretation of balance studies would lead to erroneous conclusions regarding the process of absorption. There is a certain amount of evidence to show that calcium and phosphorus, both are re-excreted into the intestine. This fact was taken into consideration by Harris[17] (1932) when he suggested the use of "net absorption" to indicate the difference between the intake of calcium and the sum of urinary and fæcal calcium. But other authors were

less careful in the use of the term absorption, and it has come to be accepted that vitamin D increased specifically the absorption of calcium from the intestine.

In 1926, Bergeim[18] introduced Fe_2O_3 together with calcium salts in the intestine and determined the ratio of Fe to Ca at various levels of the small intestine. He came to the conclusion that deficiency of vitamin D did not adversely affect the absorption of calcium. Taylor and Weld[19] (1932) also reported that vitamin D had no influence on calcium absorption. Nicolaysen[20] (1937) was the first to seek direct proof of the effect of vitamin D on absorption of calcium from the small intestine. He used the isolated loop technique of Verzar[21] (1936) and showed that in rachitic rats, the rate of absorption of calcium was slower than in the animals protected against rickets by vitamin D. Nicolaysen's results found wide and uncritical acceptance. When Patwardhan and Chitre[22] (1942) studied the absorption of calcium in three groups of rats which were (*a*) rendered rachitic, (*b*) protected against rickets by dosage with vitamin D and (*c*) rendered hypervitaminotic by massive dosage with vitamin D respectively, they could find no significant difference in the rates of absorption of calcium from the small intestine among the rats belonging to these groups.

Thus, it cannot be denied that in spite of clear-cut evidence that in therapeutic doses vitamin D increases calcium and phosphorus retention, no direct evidence of its effect on absorption from the intestine has yet been forthcoming [Wolbach[23] (1947)]. Hence no definite conclusion can be reached with regard to the mechanism by which vitamin D increases the retention of calcium and phosphorus.

It will be of interest now to discuss other manifestations of vitamin D action, particularly those affecting blood and the bone. A deficiency of vitamin D is responsible for infantile rickets (Hess[27]; Eliot and Park, *loc. cit.*). It is also responsible for experimentally produced rickets in animals (Mellanby, 1919, *loc. cit.*, and McCollum, *et al.*, 1921, *loc. cit.*). The levels of calcium and inorganic phosphorus in the serum of normal children are roughly between 10–12 mg. per cent. and 4 to 6 mg. per cent. respectively (Howland and Kramer,[24] 1923; Patwardhan, Chitre and Sukhatankar,[25] 1944). In rickets, Ca or inorganic P[24a] or both may fall below normal levels. Eliot and Park[26] (1942) state that in rickets serum calcium remains at approximately the normal level, but the inorganic phosphorus decreases considerably. They do mention the possibility, however, that calcium and not the inorganic phosphorus may be decreased. Patwardhan, Chitre and Sukhatankar (*loc. cit.*) found a greater frequency of low calcium levels than of low inorganic phosphorus in radiologically diagnosed rickets studied by them in a hospital in Bombay. What the predisposing conditions are which determine the lowering of calcium or phosphorus or of both is not yet quite clear. Whatever the condition, the administration of vitamin D in therapeutic doses, brings about a return to the normal, both in clinical as well as in experimental rickets. These changes in the blood are, however, reflected in the composition of bone. The fact that rachitic bone is poorly calcified is too well known to require elaborate description The response of rachitic animals to vitamin D resulting in increased calcification has been the basis of several methods of vitamin D assay.

There are reasons to believe that there is nothing inherently wrong with the rachitic bone. Shipley, Kramer and Howland[28] (1926) showed that slices of tibiæ from rachitic rats calcified when immersed in an inorganic solution of known composition containing Ca and inorganic P. The product of Ca and P determined whether calcification would take place or not. They also demonstrated that rachitic bone slices would not calcify in the serum of rachitic animals whereas they would if immersed in the serum of non-rachitic animals. Robison and his colleagues [Robison and Soames[29] (1930), Robison, McLeod and Rosenheim[30] (1930)] demonstrated that in the presence of organic phosphoric esters, rachitic bone would calcify *in vitro* with lower concentration of inorganic P. It is permissible to assume therefore that in rickets, bone does not calcify because the fluid environment in the immediate vicinity of the zone of provisional calcification is not suitable for promoting bone formation. Since the interstitial fluid should be in equilibrium with blood, the defect must primarily be looked for in the blood itself.

The interrelation between the mineral composition of bone and the electrolyte composition of plasma has been the basis of much work and certain hypotheses have been put forward to explain the normal process of calcification. In the main, these hypotheses postulate that when the plasma is in a state of supersaturation with respect to $Ca_3(PO_4)_2$ and/or $CaHPO_4$ the bone salt is laid down. The latter has the composition $n\ Ca_3(PO_4)_2$. CaX where X may be F^-, OH^-, or $CO_3^=$ and the value of n may vary between 2 and 3. Holt, Lamer and Chown[31] (1925) suggested that $Ca_3(PO_4)_2$ was laid down when the concentration of $[Ca^{++}]^3$ and $[PO_4^{\equiv}]^2$ in serum exceeded the solubility product. Wendt and Clarke[32] (1923) had made a suggestion that $CaHPO_4$ and not $Ca_3(PO_4)_2$ was the salt first precipitated, a hypothesis which received support from Shear and Kramer[33] (1928). Logan[34] (1940) reviewed the evidence in support of both these hypotheses including the work done by him and his colleagues and came to the conclusion that the salt first precipitated probably had the composition of $CaHPO_4$; the alteration in composition to that more commonly known was achieved by the exchange of ions. Additional evidence in favour of this hypothesis was given by freeman and McLean[35] (1941) who found that in rachitic puppies, the blood was undersaturated with respect to $CaHPO_4$ although it was not necessarily so with respect to $Ca_3(PO_4)_2$. Patwardhan, Chitre and Sukhatankar[36] (1945) also observed a similar state of affairs in experimental rickets in puppies as well as in clinical rickets in Indian infants and children. Patwardhan and Dikshit[37] (1946) followed up these observations by determining the changes

in the ionic concentration of Ca^{++}, $HPO_4^{=}$ and $PO_4^{\equiv}$ during the onset, progress and healing of rickets in puppies. They found that the process of healing indicated by radiological examination was simultaneous with or most probably preceded by a shift to the state of supersaturation with respect to $CaHPO_4$ and $Ca_3(PO_4)_2$ both. Whichever the salt that is precipitated to start with (a matter not unimportant in itself, but immaterial for the purposes of this article) it is clear that in a deficiency of vitamin D, the blood is undersaturated with respect to $CaHPO_4$ and probably also $Ca_3(PO_4)_2$, and on administration of adequate amounts of vitamin D, the serum becomes supersaturated initiating the healing of the rachitic lesion. Here again one sees the result, but the mechanism by which it is brought about remains obscure.

The curative effect on rickets shown by vitamin D is accompanied by an increase in the serum Ca or inorganic P or both. But this cannot be the only consideration in initiating repair of a rachitic bone. Nicholaysen[33] (1939) has reported that increasing the serum concentrations of Ca and inorganic P by intravenous injections did not lead to normal bone formation in rachitic animals in absence of vitamin D. It appears therefore that vitamin D influences bone formation in some other way as yet unknown. Besides, the supersaturation theory does not explain all the known facts. Firstly, bone is continually undergoing change in which the processes of demineralisation and mineralisation presumably alternate. During the growth period, it is the latter process which predominates and the bone finally assumes the shape found in the adult. During senility, it is presumably the demineralisation that assumes the upper hand, and bone in old age tends to become osteoporotic. It will not be possible to explain adequately these phenomena unless one assumes locally produced alternate stages of undersaturation and supersaturation. That bone is in a dynamic state has been beautifully demonstrated by Chiewitz and Hevesy[39] (1935) by the use of P^{32}.

The action of vitamin D when administered in massive doses is also difficult to explain. Hypervitaminosis D is a condition in which there is first hypercalcæmia and hyperphosphatemia accompanied by increased excretions of Ca and P in urine and decreased fæcal excretion of these elements. In the early stages of hypervitaminosis D, there is thus increased retention of Ca and P. When the condition becomes severe, the retention of these elements may actually decrease. It has been suggested by Harris and Innes[16] (1931) that in severe hypervitaminosis the gut function fails and hence there is decreased absorption of calcium from the intestine. Patwardhan and Chitre[22] (1942) however found, as mentioned before, that in animals with severe induced hypervitaminosis D showing decreased retention, there was no significant difference in the absorption of calcium from the intestinal loops as compared with the absorption in normal animals.

So far as bone is concerned, intense calcification is observed in early stages of hypervitaminosis D. When the condition becomes severe, demineralisation of bone takes place (Brown and Shohl,[40] 1930; Harris and Innes,[16] 1931; Patwardhan and Chitre,[41] 1938). Strangely enough this withdrawl of calcium from bone occurs with or without dietary calcium and results in a high concentration of Ca and inorganic P in blood. This latter condition may lead to metastatic calcification of soft tissues.

The observations of Ham and Lewis[42] (1934) are particularly interesting; they found that when massive doses of vitamin D were administered to young rats, a condition in epiphyseal cartilage resembling that found in low calcium rickets was produced. Thus here is an example where excess of vitamin D actually prevents calcification of the growing bone. The toxic effects of vitamin D on bone are exactly opposite of what they are when the vitamin is administered in therapeutic doses.

It must be pointed out that vitamin D has no local action (Robison and Rosenheim,[43] 1934) at the seat of calcification. Its systemic action consists, in addition to what has been described above, in a reduction of plasma phosphatase if it had increased due to rachitic lesion (Bodansky and Jaffe,[44] 1934) and an increase to normal of certain phosphoric esters of the red blood cell (Rapoport and Guest,[45] 1938). No other changes in blood have been reported either in rickets or in hypervitaminosis D which could be ascribed to the latter.

The delay in the manifestation of vitamin D action after its administration raises the question whether the vitamin undergoes any change in the body before exerting its characteristic actions. There is some circumstantial evidence in support of this concept, enough to warrant further exploration. It is well known that in a rachitic animal, the healing effect of vitamin D can be demonstrated only 24 to 48 hours after administration. Irving[46] (1944) found teeth more sensitive to vitamin D action than long bones; but in teeth too, the action was manifest only after 24 hours. Morgareidge and Manley[47] (1939) reported that the amount of P^{32} in the metaphyses of rachitic rats increased after 54 hours after the adminstration of P^{32} and vitamin D and that this increase coincided with the appearance of the healing line in the epiphyseal cartilage. In certain experiments carried out by the author (unpublished) it was found that even intravenous administration of 4,000,000 I.U. of vitamin D_2 to dogs of 11 to 12 kgm. weight caused a rise in serum calcium only after 24 hours. Against this can be mentioned the fact that the hypercalcæmic action of parathyroid hormone is manifest within a few hours and the blood calcium may return to normal within 24 hours. The delay in vitamin D action has been attributed to the possible intervention of parathyroids, for it has been suggested that vitamin D acts by stimulating parathyroids to greater activity, a suggestion which still remains to be proved. Vitamin D can act in absence of or in case of hypofunction of parathyroids and can actually relieve parathyroprivic tetany (McLean,[48] 1941; Drake and Sulkowitch,[49] 1938).

The idea that vitamin D may undergo some change in the body before exhibiting its activity

is not so far fetched as it seems. The functions which some other vitamins perform in the body are carried out in combination with proteins and certain other substances. Vitamin A, thiamine, riboflavin and nicotinic acid are the best examples of this type. Even if the above suggestion proved to be correct, there still would remain the need to find out the way in which the hypothetical derivative or compound of vitamin D would exert its action. Thus far then, there is no clue to the mode of action of vitamin D. Recent work with the radioisotopes of Ca and P with or without vitamin D has confirmed some of the earlier findings without adding anything fundamentally novel. It is a permissible conjecture that labelling of vitamin D itself, if that were possible, would yield much more valuable information on the subject.

It is difficult, however, to predict the direction which future work on vitamin D would take. There appear several possibilities which could be explored, *e.g.*, (1) search for the hypothetical vitamin D compound, (2) more precise information about the fate of vitamin D in the body and (3) preparation of simpler compounds possessing vitamin D activity.

Investigations along the lines suggested above are already in progress in some laboratories in India and abroad, and it is expected that, if successful, they will yield much needed information on the mode of action of vitamin D.

Work on vitamin D has been very much hampered by the lack of suitable physico-chemical or chemical methods of assay. Biological methods are the only methods available at present which can be relied upon to give reasonably accurate results. These are tedious, time-consuming and require large numbers of animals. Colorimetric methods have been suggested from time to time, but they fail because they are either non-specific or require large concentrations of vitamin D to be effective. Unless this obstacle is removed from the path of investigators, further progress is bound to be slow.

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INTERNATIONAL DEPOT OF MICROSCOPIC PREPARATIONS OF CYTOLOGY CREATED BY THE INTERNATIONAL UNION OF BIOLOGICAL SCIENCES

An Appeal to Cytologists

IN 1939, the International Union of Biological Sciences requested Professor P. Martens, Director of the J. B. Carnoy Institute, at Louvain, Belgium, to take up again, the project of an International Depot of Microscopic Preparations of Cytology, animal and vegetable. This plan had previously been submitted by the Union to the late Prof. V. Gregoire ; but owing to his poor health condition, he was unable to realize the practical side of this plan. On the other hand, the International situation, and the state of war, have delayed until to-day the announcement of the creation of this organisation.

It would therefore be a matter of assembling together at an easily accessible centre—the laboratory of Cytology of the *Carnoy Institute*, at *Louvain* (Belgium) — preparations obtained from numerous research centers, and having already been used as basis to previously published contributions. Each worker, interested in a definite problem, could thus locate and compare with his own documentation, the original microscopic preparations of other authors pertaining to the subject. It is hardly necessary to underline the considerable interest that a Depot of this kind would acquire a good understanding amongst workers which it would promote. The depot will serve to vain contestations, settle differences of opinion which arise and often burden the scientific litearature

But this result can only be obtained with the greatest comprehension and collaboration of the greatest possible number of cytologists. I.U.B.S. invites all cytologists therefore, from now onwards to send their works to the Laboratory, and to enclose with them several preparations having already been used as basis of publications and to refer to such deposits in future. It is *desirable* that the spots considered by authors as particularly demonstrative or used as published illustration—should be specially noted on the preparations as clearly as possible. It is also requested that a reprint of the published work should be sent.

Every Biologist, known for his publications —and any other person, possessing an authorized recommendation—will be able to consult and study as much as they like, all preparations which have been entrusted to the Depot ; the consultants will have at their disposal, the Laboratory, the equipment and necessary optical instruments. All work must be done within the Depot, except in cases, when a written permission is granted by the depositor.

The preparations will always remain the entire *property of the depositors*, who can, at any time, have them sent back to them, the cost of postage would then be paid by the administration of the Depot.

Prof. P. VAYSSIERE (Paris)
The Secretary-General of the I.U.B.S.
Prof. P. MARTENS (Leuvain)
The Administrator of the Depot.

HARWELL ATOMIC PILE

THE new atomic pile at Harwell (Berkshire) is expected to come into operation this summer when a much larger number of radio-active isotopes, with greater strength, will be produced than at present with the low-energy experimental pile, announces the Ministry of Supply.

It is estimated that this increase in production will be sufficient to meet the demands for radio-active isotopes of all research workers throughout Great Britain.

Processing, packing, and distribution of isotopes produced at Harwell will be carried out by the Radio-chemical Centre at Amersham. A statement will be issued in the near future on the services to be provided by this Centre, as regards distribution of both natural and artificial radio-active substances.

An initial supply of these isotopes was needed before the new pile came into operation, and as supplies from abroad were uncertain it was decided last July to try and supply these materials from the Gleep (Graphite Low Energy Experimental Pile) which was then nearing completion. The Gleep began to operate in August, and by the end of September the apparatus for handling the isotopes had been rushed through the workshops at Harwell.

As a result, production of radio-isotopes was started almost at the same time as the pile worked up to its rated power of 100 kilowatts. The first delivery of radio-iodine, urgently required for an operation at a Liverpool hospital, was made to the Medical Research Council on September 28, 1947.

The monthly production total of radio-isotope samples reached 120 in March of this year, of which one-third was used at Harwell. The remainder went to hospitals and research laboratories all over the country.

30,000,000 VOLT SYNCHROTRON

JUST delivered to the Natural Philosophy Department of Glasgow University is a 30,000,000—volt Synchrotron, made at Malvern (Worcestershire) by the Electronics Division of the Atomic Energy Research Establishment. The machine, which is to be used for research in nuclear physics, is expected to be in full operation this summer. It is of moderate size, being some six feet high, six feet wide and three feet deep, and weighs about five tons; and is later to be replaced by a larger machine, working at 300,000,000 volts, which is now being built in Manchester.

The Synchrotron consists essentially of a largo electromagnet, supplied with current from the mains. Between the poles of the magnet rests the "doughnut", a hollow ring, shaped vessel of ceramic material. Electrons given off by a red-hot wire inside the doughnut, travel round and round in a circle eight inches across, gaining speed at each revolution until they have energy corresponding to 30,000,000 volts. They are then allowed to spiral inwards, striking a metal target, from which very penetrating gamma rays are emitted. It is hoped later to extract the electron beam itself, though this is an operation of considerable difficulty.

The present instrument is one of a large battery of machines now being assembled by Professor Dee and his colleagues for research into the fundamental properties of nuclear particles.

VIIth INTERNATIONAL CONGRESS OF AGRICULTURAL INDUSTRIES

THE French Government has invited the VIIth International Congress of Agricultural Industries to meet in Paris from the 12th to the 18th of July 1948.

The material organisation of this Congress is the respensibility of the French Ministry of Agriculture, whilst the scientific and technical direction of the meeting belongs to the International Commission of Agricultural Industries.

Convinced that the advancement of science and industry can only be properly served by the serious study of a limited number of scientific and technical questions, this Commission have decided which subjects should be those of a general type on which Reports are to be presented to the Congress, drawn up by highly qualified international personalities. In addition there will be Communications confined to the study of particular points of these questions.

Communications from Members of the Congress, presenting a particular interest for one or other of the specialised sections will always be received favourably, but they should nevertheless be submitted for approval, to the competent section of the technical Organisation Committee and of the Executive Committee specially appointed for this work.

There will be general meetings, special section meetings, and combined meetings of several sections for the discussion of scientific questions likely to interest a group of industries.

In connexion with the Congress may be held an international exhibition of laboratory apparatus and instruments, as well as of all equipment likely to interest the industries coming within the scope of the Congress. This exhibition could include photographs, plans, sketches, sections, etc. of the various items of apparatus which, for any reason, could not be shown, and also laboratory products.

The Congress will open on *Monday July 12th*, and will finish on *Saturday July the 17th, 1948*. Further particalars may be had from the General Secretary, 18 Avenue de villars, Paris 7.

EXPENDITURE ON UNIVERSITY EDUCATION

IN the course of his address to the Special Convocation of the University of Patna held on 13-4-1948, Lord Louis Mountbatten said :—

"Finance has been a vexed question almost everywhere and particularly during the period of these two world wars. A recent British Committee on Post-war university education, for example, felt it necessary to complain that the total grant for the universities in the United Kingdom was the cost of four hours of war, and that expenditure on university education would give a better national dividend than on most forms of public works. What is true in the United Kingdom is even more true in India."

LETTERS TO THE EDITOR

PRACTICAL NUMBERS

The subdivisions of money, weights and measures involve numbers like 4, 12, 16, 20 and 28 which are usually supposed to be so inconvenient as to deserve replacement by powers of 10. It was thought that these numbers can have no important feature to justify their existence except, perhaps, a fairly high composite character. In this note we proceed to show that they have a very remarkable property which ought to have been perceived by the ancients but either forgotten or ignored by the moderns. The revelation of the structure of these numbers is bound to open some good research in the theory of numbers. A preliminary examination is attempted here.

A number N may be called a 'practical number (on account of the association aforesaid) if every number less than N, other than a factor of N, admits of partition into unequal parts all of which are factors of N. Thus the numbers less than 12, which are not factors of 12, are $5(=1+4=2+3)$, $7(=1+6=3+4)$, $8(=2+6)$, $9(=3+6)$, $10(=4+6)$, and $11(=1+4+6)$, where 1, 2, 3, 4 and 6 are factors of 12. 12 is therefore a 'practical' number.

It is easily seen that every 'practical' number greater than 2 must be a multiple of 4 or 6.

It cannot be a deficient number, that is one of which the sum of all divisors is less than twice the number, unless the deficiency is one.

Every perfect number is evidently a 'practical' number.

If N is a 'practical' number, then $2N$ and therefore $2^i N$ is also 'practical'.

Further, the highly composite numbers of Ramanujan can be shown to be 'practical' numbers.

Three special types of 'practical' numbers are noticed :

(1) The α-type :—$N_\alpha = 2^{\alpha_0} p_1^{\alpha_1} p_2^{\alpha_2} \ldots p_n^{\alpha_n}$ where

$$2 < p_1 < p_2 < \ldots\ldots < p_n$$
$$2^{\alpha_0} < p_1 < 2^{\alpha_0+1},$$
$$\text{and } p_i^{\alpha_i} < p_{i+1}^{\alpha_{i+1}} \; (1 \leqslant i \leqslant n-1).$$

In this type α_n is unrestricted. It includes even perfect numbers.

The product of the first n primes also belongs to this type. *E.g.* : $2.3.5.7.11=2310$ is a 'practical' number.

The existence of the numbers of the α-type is manifest from the well-known Bertrand's postulate.

(2) The β-type:—$N_\beta = 2^{\beta_0} p_1^{\beta_1} p_2^{\beta_2} \ldots\ldots p_n^{\beta_n}$

$$2 < p_1 < p_2 < \ldots\ldots < p_n,$$
$$p_1 < 2^{\beta_0+1},$$
$$\text{and } p_{i+1} < 2^{\beta_0+1} p_1^{\beta_1} p_2^{\beta_2} \ldots\ldots p_i^{\beta_i} \quad (1 \leqslant i \leqslant n-1).$$

Obviously, $2^{t_0} p_1^{t_1} \ldots p_n^{t_n}$ is also a "practical" number of the β-type when $t_i \geqslant \beta_i$ $(i=0, 1, 2, \ldots\ldots n)$.

This type is of wider scope than the α-type and includes it as a subclass. Ramanujan's highly composite numbers belong to the β-type but not to the α-type *E g.*: 36, 48; 180.

(3) The γ-type ;—$2^{\gamma_0}p_1$ $(2^{\gamma_0+1}p_1+1)$ where $2^{\gamma_0}p_1$ is a perfect number and 2^{γ_0+1} p_1+1 a prime

E.g.: $2.3.13 = 78$.

All 'practical' numbers less than 201 belong to one or other of the types given above as may be easily verified from the table given below:—

2	20	42	72	100	132	168
4	24	48	78	104	140	176
6	28	54	80	108	144	180
8	30	56	84	112	150	192
12	32	60	88	120	156	196
16	36	64	90	126	160	198
18	40	66	96	128	162	200

The three types envisaged here do not exhaust probably all possible cases. The general structure is, however, unknown. If the tables are enlarged, up to at least 1000, we may meet with other types. Our table shows that about 25 per cent. of the first 200 natural numbers are 'practical'. It is a matter for investigation what percentage of the natural numbers will be 'practical' in the long run.

St. Philomena's College, Mysore, *February* 7, 1948. A. K. SRINIVASAN.

THE CANONICAL CO-ORDINATE SYSTEM IN GENERAL RELATIVITY

THE canonical co-ordinate system[1] for which, at the origin, all the first order partial derivatives of $g_{\mu\nu}$ vanish and the second order derivatives are given by a set of hundred equations is well known in the literature of general relativity. It is particularly useful for exploring the neighbourhood of an event in the space-time continuum. We have not seen anywhere the Taylor expansions of $g_{\mu\nu}$ defining the canonical co-ordinate system. The expansions contain explicitly the twenty independent components of the Riemann–Christoffel[2] tensor R_{hijk}. As the metric tensor defines not only the co-ordinate system but the gravitational field itself, we have found the expansions of special interest and service in discussing the purely geometrical, as well as gravitational properties of the relativity metric. A full report is being prepared for communication elsewhere. We have thought it worthwhile to place only the expansions here on record.

We define the twenty independent components of R_{hijk} at (0, 0, 0, 0) by the following equations :

$$R_{1212} = a, \quad R_{1313} = b, \quad R_{1414} = c,$$
$$R_{2323} = d, \quad R_{2424} = e, \quad R_{3434} = f,$$
$$R_{2113} = g, \quad R_{2114} = h, \quad R_{3114} = i,$$
$$R_{1223} = j, \quad R_{1224} = k, \quad R_{3224} = l,$$
$$R_{1332} = m, \quad R_{1334} = n, \quad R_{2334} = o,$$
$$R_{1442} = p, \quad R_{1443} = q, \quad R_{2443} = r,$$
$$R_{1234} = s, \quad R_{1423} = t.$$

If the powers above the second of the coordinates of an event in the neighbourhood of the origin are ignored we have

$$g_{11} = -1 - \tfrac{1}{3}(ay^2+bz^2+c\tau^2-2gyz-2hy\tau-2iz\tau),$$
$$g_{22} = -1 - \tfrac{1}{3}(ax^2+dz^2+e\tau^2-2jxz-2kx\tau-2lz\tau),$$
$$g_{33} = -1 - \tfrac{1}{3}(bx^2+dy^2+f\tau^2-2mxy-2nx\tau-2oy\tau),$$
$$g_{44} = 1 - \tfrac{1}{3}(cx^2+ey^2+fz^2-2pxy-2qxy-2ryz)$$
$$g_{12} = \tfrac{1}{3}\{mz^2+p\tau^2+axy-gxz-hx\tau-jyz-ky\tau-(2t+s)\,z\tau\},$$
$$g_{13} = \tfrac{1}{3}\{jy^2+q\tau^2-gxy+bxz-ix\tau-myz-nz\tau+(t-s)\,y\tau,$$
$$g_{14} = \tfrac{1}{3}\{ky^2+nz^2-hxy-ixz+cx\tau-py\tau-qz\tau+(t+2s)yz,$$
$$g_{23} = \tfrac{1}{3}\{gx^2+r\tau^2-jxy-mxz+dyz-ly\tau-ozt+(t+2s)\,x\tau\},$$
$$g_{24} = \tfrac{1}{3}\{hx^2+oz^2-kxy-px\tau-lyz+ey\tau-jz\tau+(t-s)\,xz\},$$
$$g_{34} = \tfrac{1}{3}\{ix^2+ly^2-nxz-qx\tau-oyz-ry\tau+fz\tau-(2t+s)\,xy\}.$$

In the above x, y, z, τ stand for the usual x^1, x^2, x^3, x^4. The algebraic work involved in the above calculation is quite tedious, but the symmetry of the various terms at each stage provides a useful check on the details and simplifies the calculation.

Benares Hindu University, *May* 28, 1948. V. V. NARLIKAR. AYODHYA PRASAD.

1. Eddington, A. S., *The Mathematical Theory of Relativity*, 1924, 79. 2. Eisenhart, L. P., *Riemannian Geometry*, 1926, 20.

THE VANISHING OF RAMANUJAN'S FUNCTION $\tau(N)$

MAKING use of certain congruence properties of Ramanujan's function $\tau(n)$ defined by the relation

$$\prod_{r=1}^{\infty}(1-x^r)^{24} = \sum_{n=1}^{\infty}\tau(n)\,x^{n-1}, \quad |x| < 1,$$

Lehmer has recently shown that

$$\tau(n) \neq 0 \text{ for } n < 3316799.$$

More recently Chowla and Bambah have proved that

(1) $\tau(n) \equiv \sigma_{11}(n) \pmod{256}$ if n is odd ;

(2) $\tau(n) \equiv 5n^2\,\sigma_i(n) - 4n\,\sigma_3(n) \pmod{125}$ if $(n, 5) = 1$;

(3) $\tau(n) \equiv (n^2+k)\,\sigma_7(n) \pmod{81}$,
where $k = 9$ if $n \equiv 2 \pmod 3$
and $= 0$ otherwise.

In view of these results, it is now possible to state that

$$\tau(n) \neq 0 \text{ for } n < 1791071999.$$

In fact, the only possible solutions of $\tau(n) = 0$ below 26866079999 are $n = 1791071999$ and 8955359999. Since $\tau(n)$ cannot vanish except when n is a prime, it remains to be seen if any of these numbers is a prime. This has to be verified from a table of primes, which is not accessible to me at present.

Govt. College, Hoshiarpur, *June* 4, 1948. HANSRAJ GUPTA.

1. Lehmer, D. H., *Duke Math. Jour.*, 1947, **14**, 429-33 2. Bambah, R. P., and Chowla, S., *Bull. American Math. Soc*, 1947, **53**, 950-55.

PIGEONITE IN CERTAIN DOLERITE DYKES NEAR ROBERTSONPET (KOLAR)

CERTAIN "abnormal" dolerite dykes (metadolerites) from the charnockitic areas in Mysore have been described by Mr. B. Rama Rao[1] Director of Geology, Mysore Geological Department and Mr. P. R. J. Naidu, Assistant Professor of Geology, University of Mysore. Naidu, while describing the pyroxenes of such dolerite dykes near Halagur and Dodkanya (two other charnockitic areas), calls them "Pigeonite"[2]. So far, this mineral has been reported to occur in Mysore in certain "abnormal" dolerite dykes which are associated with charnockites. But in this paper is set forth a detailed description of the optical characters of pigeonite which has been for the first time noticed to occur in certain dolerite dykes near Robertsonpet (Kolar), which are not at all associated with charnockites.

These dykes cut across the general foliation of the Champion gneiss and the ferruginous quartzites with a rough east-westerly trend. Microsections of specimens of the dykes show plagioclase laths and pyroxene plates disposed in a sub-ophitic texture. Most of the felspars are plagioclase showing zoning and multiple twinning. There are occasional crystals of microcline and orthoclase.

Some of the pyroxenes are colourless while others are pinkish showing pleochroism. Many of them have reaction rims of green to bluish green hornblende. The blue tufts in the reaction rims pass sometimes into scales of reddish brown biotite. There are also intergrowths of augite and magnetite. Generally the diopside (colourless pyroxene) showing $Z \wedge C = 36°$ to 43° is intergranular but where the diopside is absent its place is taken up by altered minerals like chlorite or amphibole.

The pyroxene showing the pleochroism is *pigeonite*. It occurs as tabular prismatic crystals with an euhedral or subhedral outline. It shows positive elongation and positive optic sign, giving $Z \wedge C = 30°$ to 43°. The pleochroism exhibited by this mineral is as follows:—

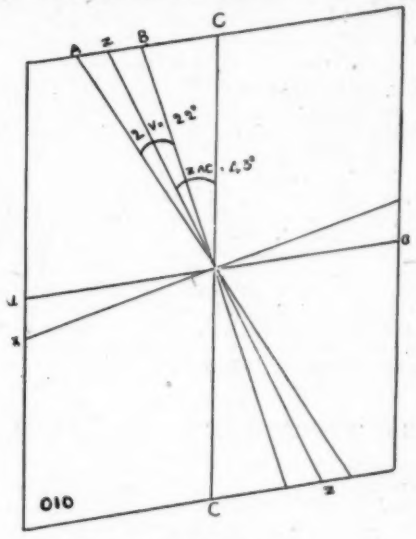
X = pink
Y = brownish pink.
Z = pale green.

Refractive Indices:—

$\alpha = 1.700$
$\beta = 1.705$
$\gamma = 1.725$
$(\gamma - \alpha) = 0.025$ (Berek's compensator)

It shows a small optic axial angle varying from almost uniaxial type where $2V = 0$ to larger angles, generally 18° to 22°. The dispersion noticed is of the inclined type where $r > v$ and hence the optic plane is parallel to (010). The parallelism of the optic axial plane to (010) indicates that this pigeonite is a calcic variety with about 7 to 10% of CaO.[3]

Wahl pointed out the general occurence of pigeonite in basaltic rocks many years ago and Fermor concluded that pigeonite was the most abundant pyroxene in nature[4]. In 1900, Winchell examined the pyroxene of the olivine diabase of Pigeon Point, Minnesota. He found that this mineral showed abnormal optical properties. He concluded that the "abnormal" optical properties of the mineral can scarcely be attributed to the chemical composition".[5] In 1906, Lacroix designated it clinoenstatite or clinohypersthene[6], but later he adopted



$2V = 18° - 22°$, + ve
$\gamma - \alpha = 0.025$
$Z \wedge C = 30°$ to 43° XZ ∥ 010
Positive Elongation
X = Pink
Y = Brownish Pink
Z = Pale Green

Winchell's pigeonite[7]. It was re-defined by H. H. Hess of the Princeton University, New Jersey, in terms of composition, as a variety of pyroxene with a calcium silicate content of W_o varying between Wo_5 & Wo_{15} ($2V = 0$ to a maximum of <32°, augite and ferroaugite $2V > 32°$).[8]

Pigeonite from the granulites of the charnockite series has been described by Dr. Groves[9]. According to him, the pigeonites of Uganda are rich in clinoenstatite or clinohypersthene molecules and are classified under the diopside-hedenbergite series. Pigeonites from the "abnormal" dolerite dykes near Halagur and Dodkanya have been described by Mr. P. R. J. Naidu. He assigns them to the enstatite-diopside series.[10]

In the case of mixtures of the minerals of the two series (enstatite-diopside series or diopside-hedenbergite series), a formula of Mallard quoted by Wahl[11] shows that the extinction angles of mixed pyroxenes would be nearer to the members of higher extinction angles and higher birefringence. The pigeonite, described in this paper, shows extinction angles ranging from 30° to 43°, and birefringence, 0·025, that is, figures approaching the extinction angles and the birefringence of the hedenbergite end of the diopside-hedenbergite series. Hence this pigeonite is assigned to the diopside-hedenber-

gite series. Computed from Winchell's Variation diagrams[1,2], it has a composition, $5CaMgSi_2O_6$. $6CaFeSi_2O_6$. Therefore this pigeonite differs from the pigeonite of charnockitic areas in Mysore in belonging to the diopside-hedenbergite series.

M. G. CHAKRAPANI NAIDU.
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Central College,
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June 15, 1948.

1. *Records M. G. D.*, 1940, **39**, 51. 2. *Curr. Sci.*, **12**, 4. 114–115. 3. A. N. Winchell, *Elements of Optical Mineralogy*, 1933, **2**, 222. 4. *Records G S. I.*, 1925. **58**, 323. 5. *American Mineralogist*, 1900, **26**, 203. 6. *Bull. Soci. Nat. Onest.*, 1906. **6**, 81. 7. *Mineral France*, 1910, 767. 8. *Amercian Mineralogist*, **26**. 517–518. 9. *Q. J. G. S.*, **91**, 155. 10. *Curr Sci.*, **12**, 4. 115. 11. Tschermak's Min. U. Pet. Mitther l., *New Series.*, 1907, **26**, 116. 12. A. N. Winchell., *Elements of Optical Mineralogy*, 1933 **2**, 226.

BAND SPECTRUM OF THALLIUM IODIDE

IN a previous letter,[1] it is reported that bands of Thallium Iodide have been photographed in two regions: (1) from λ 5300 to λ 3750 and (2) from λ 3680 to λ 3600; the first presenting extensive groups mostly of red degraded bands and the second consisting of a few sequences of a brief system of violet degraded bands. Further work on these bands has shown that the first group of bands, interpreted previously as forming two overlapping systems, could be arranged into a single system corresponding to the transition $^3\Pi_1 \rightarrow {}^1\Sigma^+$ with the (0,0) band at 25780·0 cm.$^{-1}$ and having the vibrational constants $\omega_e' = 94$ cm.$^{-1}$, $\omega_e'' = 122$ cm.$^{-1}$ and $\chi_e''\omega_e''$ having a small value, as observed previously. The analysis of the second brief system has led to the constants $\omega_e' = 150$ cm.$^{-1}$ and $\omega_e'' = 122$ cm.$^{-1}$ Considering this system as due to the transition $^3O^+ \rightarrow {}^1\Sigma^+$, the wave-number interval between the (0,0) bands of the two systems is found to be 1321 cm.$^{-1}$, which is in keeping with the corresponding intervals of the other similar halide molecules. A complete discussion will be published elsewhere.

Andhra University,
Waltair,
April 30, 1948.

P. TIRUVENGANNA RAO.
K. R. RAO.

1. *Curr. Sc.*, 1948, **17**, 121.

ON SOME PHYSICO-CHEMICAL EVIDENCE OF THE DIVALENCY OF SILVER

THE following physico-chemical evidence supports the theory of divalency of silver.

Values for certain physical constants of silver, calculated on the basis of the divalency of the metal, are in good agreement with observed values for (*a*) vibration frequencies of atoms, (*b*) entropy, (*c*) distance of the closest approach of atoms and (*d*) velocity of sound.

The formulæ proposed by the author and employed in calculating the physical constants are as follows:—

1. $v = \sqrt{K}.v\frac{1}{2\pi}\sqrt{\frac{P-V}{V}.\frac{Ze^2}{r^3}.\frac{N}{M}}$, for vibration frequencies of atoms;[1]

2. $S_T = 3/2\,R\ln\frac{M}{\left(K.\frac{P-V}{V}.\frac{Ze^2}{r^3}\right)} + 3R\ln T + 2/3\left(Cp^2\frac{T}{T_s} + A_0\right) + C$, for entropies of metallic elements[2];

3. $D = f_1 \times f_2\,(v)\,\frac{P}{V_i \times d^{K_1}}$, for distance of the closest approach of atoms;[3]

4. $S = L\left\{\left(\frac{1}{2\pi}.\sqrt{K}\sqrt{\frac{P-V}{V}.\frac{Ze^2}{r^3}.\frac{N}{M}}\right) \times \left\{f_1 \times f_2\,(v)\,\frac{P}{V_i \times d^{K_1}}\right\}\right.$, for the velocity of sound in metallic elements.[3]

In the above formulæ, P is parachor ($P_{A_g} = 63$); V, atomic volume ($V_{A_g} = 10.3$); Z, valency; *e*, elementary charge; *r*, atomic radius ($r_{A_g} = 1.77$);[4] M, atomic weight; T, temperature (298.1); T_s, temperature of fusion; V_i, ionisation potential ($Vi_{A_g} = 7.54$); *d*, atomic diameter; N, Avogadro's constant: $\sqrt{K}$, a constant with value 0.415×10^{12}; K, 0.1722×10^{24}; A_0, 0 214; C, 96.5; R, 8·32; $f_1 \times f_1$ (v), 0.615 for monovalent elements, 1·165 for bivalent elements, 1·05 for trivalent elements; K_1, 0·925; L, 2·54.

These formulæ, it should be noted, gave values in comparative agreement with the experimental ones for these physical constants in an appreciable number of cases.

The following table gives values of the above physical constants for silver, calculated on the basis of the divalency of the metal. The corresponding values, calculated on the basis that silver is monovalent are also given for comparison.

Physical Constants	Calculated values, Silver, Divalent	Calculated values; Silver, Monovalent	Values observed (and reference to authors)
Atomic frequency	3.21×10^{12}	2.27×10^{12}	4.5×10^{12}[5]
Entropy ..	50·08	56·8	42·7[6]
Distance of closest approach of atoms	3·026	1·596	2·876[7]
Velocity of sound	2467	920	2645[8]

It would be observed from the above table that the values of the physical constants for silver, calculated on the basis of its divalency,

are in better agreement with the observed values.

Chemical Laboratory, BINAYENDRA NATH SEN.
Burdwan Raj College,
Burdwan,
January 14, 1948.

1. Sen, B. N., *J. Indian Chem. Soc.*, 1934 **11**, 243. 2. —, *Chem. Phys.*, 1935, **32**, 300. 3. —, *Gazetta*, 1938, **10**, 68, 656-662. 4. Bragg, *Phil. Mag.*, 1920, **6**, 40, 169. 5. Nernst and Lindemann, *Z. Electrochem.*, 1911, **17**, 822. 6. "International Critical Tables," Vol V, 87. 7. Bragg, *X-Rays* and Crystal Structure, p. 163. 8. "International Critical Tables," Vol. VI, 465.

STUDIES ON THE SUITABILITY OF SUGARCANE JUICE FOR THE GROWTH AND DISTRIBUTION OF SOME INTESTINAL PATHOGENIC BACTERIA

THE increase in the incidence of some intestinal infections during the warmer months in Bombay and the heavy sale of iced sugarcane juice as a drink suggested the possibility of the spread of some of the intestinal pathogenic bacteria through this source. The incidence of typhoid, paratyphoid, dysentery and cholera infections usually after the conclusion of certain religious fairs, *e.g.*, Pandharpur and Nasik, where large quantities of juice are consumed by pilgrims indicates this possibility. The suitability of this drink as a vehicle for the transmission of these infections, and as a medium for the growth and viability of *E. typhosa*, *S. paratyphi*, *S. schottmuelleri*, *S. dysenteriæ* (Shig.), *S. paradysenteriæ* (Flexner), *E. coli communis* and *V. choleræ* has been studied.

The following is the average composition: Moisture 75·14%; total sugars (including the 1·16% of the fermentable monosaccharide) 13·60%; total proteins 0·24%; the other constituents which make up the remaining are pectins, lignins, crude cellulose, amides, aminoacids, gums and minerals. The PH of the juice varies from 6·8-7·0.

The microbiological examination of the juice revealed that the normal flora consists of Gram positive sporulating aerobic bacilli, *B. coaerens*, *B. ruf scens* and a starch hydrolysing variant of *B. mesentericus*, *Micrococcus perflavus* and an unidentified *Saccharomyces*. The essentially Gram positive character of the above flora enabled us to study conveniently the fate of the different Gram negative test organisms even in the non-sterilized samples of the juice.

A number of preliminary studies with the undiluted, 50% diluted, unfiltered, muslin-filtered, steam-sterilized and filter-sterilized samples were made: during these studies, methods essential for determining viability, multiplication, virulence and pathogenicity were also standardized. Sugarcane juice for the experimental studies was used in six different dilutions, *viz.*, 1 : 32 (3⅛% solution), 1 : 16 (6¼%), 1 : 8 (12½%), 1 : 4 (25%), 1:2 (50% solution), and in the undiluted state. These dilutions were used in their non-sterile, filter-sterilized and also steam-sterilized states. These various samples were then seeded in test-tubes with 0·1 m'. saline suspensions (matching Opacity Tube No. 4) of 24-hour growths of the selected bacterial species and incubated at the room temperature (28° C.) after 0·1 ml. portion from each tube was removed for the quantitative estimations of the inoculated bacteria. Further 0·1 ml. portions removed from each tube at regular intervals of time were utilized for counting the bacteria by the methods worked out for the purpose[1] in this laboratory. Special media such as the MacConkey's agar, Wilson and Blair agar, Leifson's desoxycholate citrate agar and Aronson's agar, were utilized for the quantitative studies, and peptone water, nutrient broth and MacConkey's broth, for testing viability. The morphological, staining, biochemical and antigenic variations occurring in the bacteria were also followed by adopting suitable techniques. The results obtained indicate that multiplication and maximal survival periods for these bacteria vary not only from species to species, but also with regard to the dilution effected, the sterility status of the juice and other factors. It should be mentioned here, however, that the presence of *E. typhosa* and *S. schottmuelleri* in cane juice must be regarded as potentially dangerous in view of the fact that these bacteria are more tolerant to the juice (particularly the unheated samples) and that they not only show a multiplication stage but continue to live in this substratum for a few days without any appreciable loss in their general characteristics. Shiga and the Flexner dysentery strains, on the other hand, do not find the juice very favourable for growth; observations with *E. coli* show that his organism can and does remain potent in the juice and as such its presence in large numbers in the juice must be regarded, as we do in water analysis, as an index of contamination through fæces, soil, flies, finger, ice or other sources. For the cholera vibrios the cane juice, despite its fermentable saccharose contents, is a poor medium and consequently the danger of cholera infections through this channel is very remote.

Details of these investigations will be sent for publication elsewhere. In the meantime, it is pertinent to mention here that thus far three cases of infection (one of typhoid and two of food-poisoning) have been brought to our attention and all these cases had their suspected origin to this drink. Unfortunately, these cases came in too late for bacteriological confirmation.

Microbiology Dept.
St. Xavier's College, J. V. BHAT.
Bombay, RODA N. REPORTER.
January 28, 1948.

1. Reporter, R. N., "Suitability of certain foods and drinks for the growth and distribution of some intestinal pathogenic bacteria," *M.Sc.*, Thesis, Bombay Univ., 1944.

AN INSECT TUMOUR AND OVARIAL HORMONE

SULC[1] was the first to discover a rectal tumour in Fulgorid insects. Buchner[2] confirmed this, adding that "the most remarkable fact about this organ is that it is always found in the female, a circumstance which escaped Sulc." While at Brünn, in Czechoslovakia, I found *Fulgora europœa* easily available. For over two months, about ten female insects were dissected daily, as a routine, but only once did I come across a specimen where the rectal tumour was absent. When its ovary was examined it was so atrophied as to be considered absent; the genital armature had to be examined to be sure of the sex identity. The above finding established clearly the simultaneous absence of a normal ovary and that of the rectal tumour which thus confirms Buchner's observations and explains the influence of the ovarial hormone on the growth of the rectal tumour.

The brief mention that the rectal tumour was absent would naturally convey the notion that the germ or symbiote, found in the rectal tumour, was altogether wanting from the insect body. From the writings of Sulc it is by no means clear whether each tumour has its special micro-organism. In *Tettigometra obliqua* he finds many tumours but only of three types. One, which he calls the clump-forming tumour, is divided into four units, but represents morphologically the same structure. Thus, according to Sulc, there would be only three symbiotes, one for each type of tumour. In fact, he has illustrated the three germs as morphologically different, in Figs. 51, 53 and 54. In the case of *Fulgora europœa* he has, unfortunately, not given illustrations of the germs in symbiosis with it. He has however done this with *Oliarus cuspidatus*, where Fig. 6 represents the germ found in the rectal tumour and Fig. 9 that in the clump forming tumour. Now Buchner[2] has subsequently shown that, in *F. europœa*, the germ in the rectal tumour is identical with that found in, what Sulc calls, the clump-forming tumour. I have confirmed this observation by isolation. The germ of *F. europœa* is a pigment producer, identical with the yellow colour found within the body of the insect. That of *O. cuspidatus* produces a red pigment, probably β-carotene. What is interesting is that these germs produce zoogloeal colonies which unwittingly induced Sulc to give the appropriate term, clump-forming tumour. The absence of rectal tumour thus does not mean the absence of the symbiote, for it is always present in the clump-forming tumour. The formation of the rectal tumour is thus not so much a microbiological phenomenon as a physiological one, being more intimately connected with the function of the female sex hormone.

Now all homopterous insects have tumours on either side of the abodomen. It is equally well known that they are better developed in the female, which thus indicates the share of the female sex hormone. There are germs that directly induce cell multiplication. Mary,[3] in the chapter on the Colloid Chemistry of Tuberculosis, writes that "when we speak of tuberculosis tissue it is not a question of an altered normal tissue. A neoplastic formation is in reality involved for whose formation no bacillus is essential, the agent being always of a toxic nature... (Tissue culture experiments indicate) histological changes of tuberculosis (with) figures showing mitosis." Like the germ of tuberculosis, that of leprosy, also induces new cellular growth. Symbiotic germs of insect tumours probably do the same. That of *Cicadella viridis*,[4] already isolated, secretes phosphatases which would go to attribute such a property. However, in insects with rectal tumours the new growth is the combined result of bacteria and that of the female sex hormone, where the latter is the leading factor.

S. MAHDIHASSAN.

Biochemical Laboratory,
Cipla Ltd.,
Bombay,
April 26, 1948.

1. *Pub. biol. Ecoles Haut Etudes veter. Brunn.*, 1924, 3. 2 *Zeit. f. Morph. u. Okolog.*, 1925, 4, 3. *Alexander, Colloid Chemistry*, 2, 872-3. 4. *Curr. Sci.*, 1947, 16, 58.

2-THIOL-4 : 5-DIPHENYLIMIDAZOLE DERIVATIVES

CORRELATING the chemical structure and sympathomimetic activity, Barger and Dale[1] enunciated the "β-phenylethylamine rule" which states that "the optimum constitution of fatty aromatic amine for the production of sympathomimetic action is, ...that which is found in adrenaline itself, viz., a benzene ring and a side chain of two carbon atoms of which the second bears the aminogroup". Imidazole derivatives[2] have recently come to the forefront as possible sympathomimetics, the 2-α naphthylmethylimidazoline (Privine) having already been introduced into medicine. Further, S-methylisothiourea sulphate[3] has been reported to overcome fall of blood pressure in spinal anæsthesia.

With a view to studying the pressor activity of compounds possessing all the structural characteristics detailed above, a number of 2-thiol-4:5-diphenylimidazole derivatives (*vide* table) of the type (I) have now been synthesized. Müller[4] prepared N-aryl derivatives of 2-thiol-4:5-diphenylimidazole by heating benzoin with N-substituted thioureas and alcohol, in sealed tube at about 180-90° C. for 4-5 hrs. Biltz and Krebs[5] prepared 2-mercapto-4, 5-diphenylimidazole by fusing benzoin and thiourea in the absence of any solvent. Extending the latter method to N-substituted thioureas, compounds 12, 13, 16 and 19 (*vide* table) have been prepared by fusing benzoin with the appropriate thiourea at about 200° C. and purifying the products directly by crystallisation after removing the reactants, or through their alkali salts.

By the action of the corresponding halogen compounds in alcoholic solution on the appropriate 2-thiol, 4, 5-diphenylimidazole, the thioethers Nos. 1 to 11, 14, 15, 17 and 18 (*vide*

TABLE

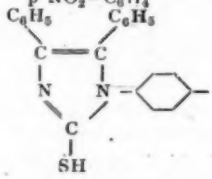
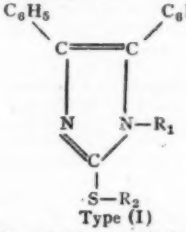
No.	R_1	R_2	M.P.° C.
1	H	$-CH_2-CH_2-CH_3$	174
2	H	$-CH_2-CH=CH_2$	181-2
3	H	$-CH_2-CO-CH_3$	150-1
4	H	$-CH_2-CH_2-OH$	167
5	H	$-CH_2-COOH$	216
6	H	$-CH_2-C_6H_5$	185-6°
7	H	$-C_6H_4-NO_2-p$	209
8	H	$-C_6H_2-(NO_2)_3$ 2, 4, 6	186 (decomp.)
9	C_6H_5	$-CH_2-CO-CH_3$	153-4
10	C_6H_5	$-C_6H_3(NO_2)_2$ 2, 4	199-200
11	C_6H_5	$-C_6H_2(NO_2)_3$ 2, 4, 6	205-6 (decomp.)
12	o $CH_3-C_6H_4$	H	288-9 (decomp.)
13	p $CH_3-C_6H_4$	H	319-20 (decomp.)
14	p $CH_3-C_6H_4$	$-C_6H_3(NO_2)_2$ 2, 4	233
15	p $CH_3-C_6H_4$	$-CH_2-C_6H_5$	191
16	p $CH_3O\,C_6H_4$	H	297 (decomp.)
17	p $CH_3O\,C_6H_4$	$-CH_2-C_6H_5$	191-2
18	p $CH_3O\,C_6H_4$	$-C_6H_2-(NO_2)_3$ 2, 4, 6	168 (decomp.)
19	p $NO_2-C_6H_4$	H	284 (decomp.)
20			does not melt even at 340

table) have been prepared. Two molecules of benzoin reacted with *p*-phenylene bisthiourea to give compound 20.



Type (I)

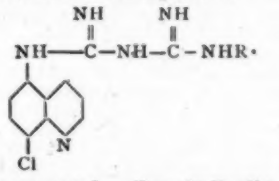
Full details will be published elsewhere.

Organic Chemistry Laboratories, M. V. BHATT.
Indian Institute of Science, B. H. IYER.
Bangalore, P. C. GUHA.
April 1, 1948.

1. Barger and Dale: *J. Physiol.*, 1909, **41**, 19. 2. Scholz, *J. Ind. and Engg Chem.*, 1945, **37**, 120-5. 3. Smirk and McGeorge, *Lancet*. 1912, **243**, 301. 4. Müller, *Annalen*. 1894, **284**, 25-35. 5. Biltz and Krebs, *ibid.*, 1912, **391**, 194-95.

STUDIES IN ANTIMALARIALS SOME N¹-(8-CHLORO-5-QUINOLYL)-N⁵-SUBSTITUTED BIGUANIDES

IN continuation of our work on quinoline substituted biguanides as possible antimalarials,[1] a number of N¹-(8-chloro-5-quinolyl)-N⁵-substituted biguanides of type (I) have now been synthesised. May, *et al*[2] have prepared a few methoxy-8-quinolyl biguanides but found them inactive against blood inoculated *P. gallinaceum* infection. In the present



type (I)

series of compounds, the similarity to paludrine[3] is kept up in that the biguanide chain is at 5-position and the chlorine atom at the 8-position of the quinoline nucleus. It may also be interpreted that a pyridine ring is fused to the p-chlorobenzene nucleus, present in paludrine and it is hoped that they will be active against malaria parasites.

The compounds (*vide* Table I), were prepared by condensing 8-chloro-5-amino-quinoline hydrochloride with the appropriate cyanoguanidines in alcoholic solution. The base was liberated from the reaction mixture by treating it with dilute alkali solution and purified by recrystallising from organic solvents. The acetates prepared in the usual manner, were purified by recrystallisation from absolute alcohol and dry acetone.

While both the base and the salt (No. 1 in Table I) from the reaction with cyanoguanidine contain one molecule of water of crystallisa-

tion, none of the other bases or salts contain any water of crystallisation.

No.	R	m.p. of base	m.p. of salt
1	$-H, H_2O$	213° C. (d)	229–30° C. (d)
2	C_6H_5-,	198 (d)	188-189 (d)
3	$p\text{-}CH_3\text{-}C_6H_4-$,	170–171 (d)	288 (d)
4	$p\text{-}CH_3O\text{-}C_6H_4-$,	210–11 (d)	182–183 (d)
5	$p\text{-}CH_3CONHC_6H_4-$.	194–96 (d)	242–43 (d)
6	$p\text{-}NH_2\text{-}C_6H_4-$,	165–66° C. (d)	228–30° C. (d)
7	$p\text{-}NO_2\text{-}C_6H_4-$,	207 (d)	214–15 (d)
8	$p\text{-}Cl\text{-}C_6H_4-$,	214 (d)	143–44 (d)
9	$p\text{-}Br\text{-}C_6H_4-$,	210–11 (d)	160–62 (d)
10	$p\text{-}I\text{-}C_6H_4-$.	152° C.	269–70° C. (d)

Full details will be published elsewhere.

Our sincere thanks are due to Dr. B. H. Iyer for his ungrudging help and to the Lady Tata Memorial Trust for the award of a research scholarship to one of us (P. R. Gupta).

P. R. Gupta.
P. C. Guha.

Organic Chemistry Laboratories,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
April 19, 1948.

1. Gupta, P. R., Iyer, B. H., Guha, P. C., *Current Science*, 1948, **17**, 53. 2. May, E. L., *et al*, *J. Org. Chem.*, 1947, **12**, 869. 3. Curd, F. H. S., *et al*, *J. C. S.*, 1946, 729.

ARYLCYANOGUANIDINES FROM ARYLAZOCYANOGUANIDINES

Walther and Grieshmmer[1] converted the arylazocyanoguanidines referred to as triazene) into their labile hydrochloride salts which on treatment with hot water liberated the azo-nitrogen to give arylcyanoguanidines. It has been possible to denitrogenate the above type of triazenes in a mixture of a hydrolytic solvent and acid at low temperature to get the required products.[1,2,3] Consequently a systematic study of p-chloro-phenylazocyanoguanidine has been made in various mixtures of hydrolytic solvents and acids and it has been observed that a mixture of acetone, acetic acid or dioxane with hydrochloric acid or sulphuric acid at 30-40° C. gives best yields of p-chlorophenylcyanoguanidine (an important intermediate for the synthesis of paludrine). Only a few arylcyanoguanidine have been prepared.[3] The following new substituted arylcyanoguanidines have been prepared by this method which have been used as intermediates for the synthesis of substituted biguanide as potential antimalarials :—

2 : 4-Dichlorophenylcyanoguanidine (217° C. m.p.); o-Chlorophenylcyanoguanidine (170°); *meta*-chlorophenylcyanoguanidine (232-33°); *m*-bromophenylcyanoguanidine (233°); p-iodophenylcyanoguanidine (217°); p-fluorophenylcyanoguanidine (211°); *o*-methylphenylcyanoguanidine (205°); *m*-methylphenylcyanoguanidine (202°); p-cyanophenylcyanoguanidin; (244°); *m*-nitrophenylcyanoguanidine (229°) and *β*-naphthylcyanoguanidine (237°).

Attempts to prepare N^4-cyanoguanidino sulphanilamides from the corresponding triazenes have failed due to the non-formation of labile hydrochlorides of these triazenes which are perhaps necessary for such a denitrogenation[1]. This was due to the acidic nature of the substituents in the phenyl ring which hindered the formation of such a intermediate labile salt. It has also not been possible to obtain similar triazenes derived from trihalogen substituted anilines and 2-aminothiazole, while both the diazonium groups derived from benzidine have reacted only with one molecule of cyanoguanidine.

Full details of this work will be published elsewhere.

Thanks are due to Professor P. C. Guha and Dr. B. H. Iyer, for their guidance and kind interest and to the Indian Research Fund Association for the award of a fellowship.

H. L. Bami.

Organic Chemistry Laboratories,
Indian Institute of Science,
Bangalore,
May 3, 1948.

1. Walther and Grieshmmer, *J. fur Prakt. Chem.*, 1915, **92**, 209. 2. Bami, Iyer and Guha, *J. Indian Inst. Sci.*, 1946, **29A**, 1, 15. 3. Broadbent and Rose, U. S. Patent 2409832, 1946.

TAMARIND AND CHILLIES—THEIR EFFECT ON S. INDIAN DIET

The work of Krishnamurti, De and Subramanyan[1] on the above subject is extremely interesting. But, it is in apparent variance with the work of earlier nutrition schools. Chillies and Tamarind are good sources of vitamin C. It is well known that such natural sources of vitamin C usually contain vitamin P (also called Citrin or C_2). The work of Cotereau and others[2] shows that vitamin P plays a very important role in the absorption and retention of vitamin C. Chillies and red pepper are good sources of vitamin P just like cabbages, citrus fruits, buck-wheat and lemon peel. Chillies form a daily article of diet in the food of the South Indians and of most other Asiatics. In spite of an apparently poor diet, the population of S. India cannot be definitely said to be of lower vitality. This anomaly is due probably to the intake of vitamin P in the chillies and tamarind. The idea is being pursued.

Medical College,
Poona, N. N. Narayana.
May 10, 1948.

1. Krishnamurti, *et al.*, *Curr. Sci.*, 1948, **17**, 51. 2. Cotereau, *et al.*, *Nature*, 1946, **158**, 343. *Ibid.*, 1948, **161**, 557.

NOTE ON THE RECOVERY OF OIL FROM SEED CAKES OF OIL EXPELLERS

NARASINGA RAO AND SUBBAIAH,[1] have enriched the sugar factory press-cake with respect to its wax content, by a simple froth flotation process. Similar experiments were conducted with an oil-cake containing 12·3% oil. The material is ground up with water, and the slurry is froth floated in a small Callow's cell.

Expt. No.	Conditions	Froth		Gangue	
		Wt. % Cake	Oil %	Wt. % Cake	Oil %
1	10% slurry + ·5 c.c. pine oil per litre	32	22·5	68	7·5
2	15% slurry + ·5 c.c. pine oil per litre	27	20·2	73	9·3
3	10% slurry alone	21	21·1	77	9·9

The emulsion was extracted with petroleum ether for estimating the oil. The separation of the emulsion was also attempted in laboratory Sharple's super-centrifuge with promising results. A study of the factors which control this separation is now in progress.

Thanks are due to Dr. M. Narasinga Rao, Technology Laboratories, Andhra University, Waltair, for suggesting the problem and for guidance.

Chemistry Department,
Mrs. A. V. N. College, Vizagapatam,
June 5, 1948.

K. SATYANANDA RAO.
R. SUBBAIAH.

1. *J. Sci. Ind. Res.*, 1947, **68**, 178.

A NOTE ON "THE FORMATION OF COMPLEX COMPOUNDS BETWEEN LEAD NITRATE AND ALKALI NITRATES"

ACCORDING to Ephraim,[1] "Nitrates do not easily form complex compounds in which several NO_3 groups co-ordinate with a metal atom. The number of easily dissociated nitrato salts, the so-called double nitrates, is not comparable with that of double halides or sulphates. Almost the only metals which can act as central atoms in double nitrates are those with high atomic weights, in particular Ba, Hg, Au, Tl, Pb, Th and Bi. The formula of potassium barium nitrate, $K_2[Ba(NO_3)_4]$, serves as an example of the constitution of these compounds".

When aqueous solutions are prepared in such a way that the concentration of alkali nitrate is kept constant while that of lead nitrate is systematically varied and the physico-chemical properties of the solutions are measured and plotted with respect to the concentration of $Pb(NO_3)_2$, regular curves are obtained in some cases, while abnormalities with specific maxima are observed in others. There is excellent similarity in the curves with respect to all the physico-chemical properties, so that there is no question about the genuineness of the phenomenon. Maxima occur at exact stoichiometric ratios of concentrations corresponding to the compounds :—

4 $RNO_3.Pb(NO_3)_2$, 2 $RNO_3.Pb(NO_3)_2$ and $RNO_3.Pb(NO_3)_2$ (where R = K, NH_4 or Rb). No abnormalities, however, are observed in the case of $LiNO_3$ (or $NaNO_3$)-$Pb(NO_3)_2$-H_2O systems.

When attempts are made to prepare these compounds from solution by evaporation or cooling, the constituents separate out indicating that these compounds are stable only in solution. The physico-chemical properties employed for their detection were : viscosity, rheochor, parachor, conductivity, freezing point, E.M.F., magnetic susceptibility, pH and transport number. The compounds are produced in solution presumably according to the equation :

$$x\,KNO_3 + Pb(NO_3)_2 \rightleftharpoons K_x[Pb(NO_3)2+x]$$

(where x = 1, 2 or 4). That such a reaction does take place is convincingly indicated by experiments on transport number, where the cationic Pb is seen to be converted to anionic Pb. Therefore in solution the equilibrium shown above shifts to the right, while on crystallisation there is rapid reversal, so that crystals consist of either KNO_3 or $Pb(NO_3)_2$ or a mixture of the two.

The fluoberyllates and chloroberyllates reported by Purkayastha[2] probably behave similarly.

Full details of our work on the complex nitrates of lead appear in the *Proceedings of the Indian Academy of Sciences*[3]

The Department of Chemistry,
Lucknow University,
Lucknow,
June 8, 1948.

M. R. NAYAR.
C. S. PANDE.

1. Fritz Ephraim, *Inorganic Chemistry*, 4th edition, 1943, 699. 2. *J. Indian C.S.*, 1943, **25**, 81; 1947, **24**, 257. 3. *Proc. Indian Acad. Sci.*, April 1948 and subsequent issues.

PROTHALLUS OF *LYCOPODIUM HAMILTONII* SPRING

IN 1938, while describing the species of *Lycopodium* in the Bombay Presidency, the rare occurrence of an epiphytic species, *L. Hamiltonii* was noted by me.[1] The material on which this observation was based came from Ainsi, a village in the forests of North Kanara District. Subsequently lot of material of the same species came to my hands through the kindness of Professor H. G. Champion and Dr. S. P. Agharkar who had collected it at Lohjang, Kailganga Valley in the Garhwal Himalayas and at Mawphalong in Assam respectively. A comparison of this material with the one I had from the Bombay Presidency clearly showed that under the name *L. Hamiltonii* several species have been lumped together, which now have been rightly separated into *L. Hamiltonii* proper, *L. aloifolia*, *L. petiolatum*, *L. obtusifolium* by Chowdhury.[2]

On a recent collecting trip to Lonawala during last August, some specimens of this species proper were noticed on the tree trunks of *Holigarna Grahamii*, *Mangifera indica*, etc., at

a height of about 30-40 feet on fully grown trees thriving luxuriantly in a cool and shady grove. Curiously enough, the plants though epiphytic were not pendulous as in *L. Phlegmaria* and other epiphytic species but were erect or suberect. Their bases were enveloped in rich humus and blue green algæ growing together with some grasses, orchids such as *Eria Dalzelii*, *Eria crispa*, and ferns such as *Nephrolepis paucifrondosa*, *Leucostegia oulchra*, etc. Within this particular locality the lycopod was fairly common on the tree trunks and older branches at great heights, but outside the locality it was not noticeable at all. This suggests that like *Psilotum triquetrum* Sw. growing not very far from this locality[3] this lycopod also is both local and rare. The fully formed plants were about a foot long, occasionally epiphytic.[4] The vegetative propagation by means of bulbils seems to be the main mode of propagation in this lycopod as in several other species. It thrives in the monsoons and forms spores from about August to October. The older branches gradually die out but the young ones survive and the plant is able to parennate thereby.[5]

The species belongs to the subgenus "*Urostachya*" and to the group "*Selago*" in which the axillary sporangia are not clustered into a cone, but rather alternate with the vegetative parts on the plant (Fig. 2). The spores are finely tuberculated, the tubercles being mainly present on the lower hemispherical face, sometimes fusing into irregular thickening (Fig. 4).

Repeated attempts were made to find the prothalli on subsequent occasions and resulted

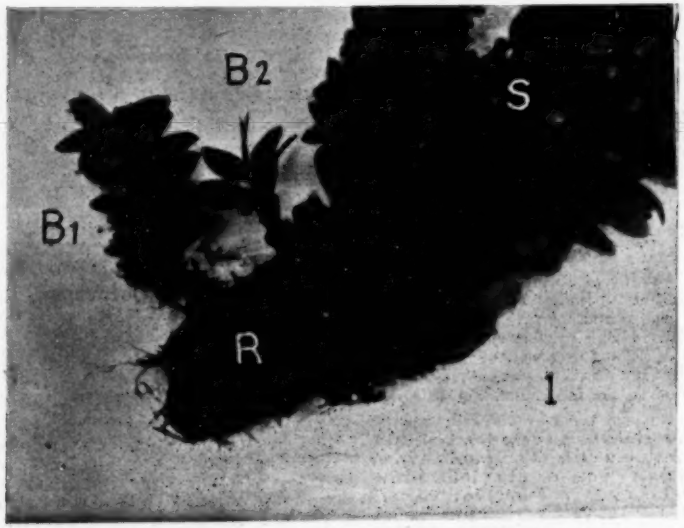
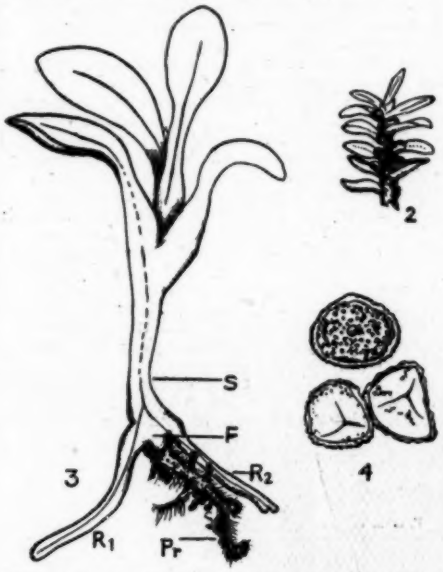


FIG. 1. *L. Hamiltonii* Spring × N. S. R–the mattress of roots at the base of the plant showing suberect branches – S. B_1 and B_2– bulbils arising from the axils of older leaves from the hinder parts of the plant.

having 6-7 suberect or erect, dichotomised branches. The hindermost part of the plant consisted of a thick mattress of roots which had collected some humus in which were growing small bulbils, and a few sporelings occasionally (Fig. 1). The dichotomised branches were springing from this part and bore sporangia in the axils of leaves towards the apices (Fig. 2). The lower part of the shoots was sterile but a few bulbils were seen developing on them in the axils of some old leaves which possibly had remained dormant during the past years and had not formed the sporangia (Fig. 1). The bulbils were easily detachable from the parent plants and a few of them had fallen on the ground below the tree on which the lycopod was growing: a few of them were also noticeable on the adjoining trees. The species appears to be facultatively terrestrial quite opposite of *L. varium* from New Zealand which is mostly terrestrail but in obtaining 4 prothalli attached to the germ plants growing deep in the humus collected by the network of roots. All the four specimens were fairly well advanced and had sporophytes attached to them. No early stages or the young prothalli were seen, as it was rather late in the season, that this lycopod was collected this year. At the same time to collect or search prothalli on moist slippery branches of trees at a height of about 30-40 feet on tall tree trunks or branches is not an easy task. The young plants attached to the bulbils, but they have a close resemblance to the bulbils, but they have a very delicate stem with long internodes, and one or two roots only (Fig. 3). They also do not arise in the axils of older leaves or lie there as do the bulbils. As the prothalli in none of the epiphytic species of the genus *Lycopodium* in India have been described, I venture to give here a brief account of the prothallus in this species, notwithstanding the

small number of specimens with me. I hope to give a detailed account if and when some more specimens become available.



FIGS. 2-4. *L. Hamiltonii* Spring. Fig. 2. Apex of a shoot showing axillary sporangia of the *Selago* type × N. S. FIG. 3. The prothallus with a young sporophyte attached to it × 8. S. – Primary shoot; F-foot; R_1 – first root; R_2 – second root on the germ plant; Pr – prothallus. Note the paraphyses and rhizoids growing in great profusion on the prothallus. Fig. 4. Spores × 220.

The prothallus shown in Fig. 3 is typical of the specimens with me and is probably typical for the species. It consists of a long drawn out, stout central conical portion with several lateral branches ramifying in the humus in which it was found growing. Empty antheridia are noticeable on the lateral branches and archegonia on the central stout conical portion only. Numerous rhizoids and paraphyses are seen all over the prothallus except near the terminal part where the embryo is seen attached to the prothallus. There is no "*Primary Tubercle*" in this species as in *L. cernuum* or *L. ramulosum* (see Mahabalé,[6] 1937). The foot is highly conspicuous and transperent. The lateral antheridia-bearing branches are pale yellow in colour but the central conical part and the lowermost part of the prothallus are dark brown. It is quite evident from this that the structure of the prothallus in this species agrees in general with the structure of the prothallus in other epiphytic species such as *L. Phlegmaria* described by Trueb[7] (1886), in *L. Billardeiri* described by Edgerley[8] (1915) and Holloway[9] (1920), and in *L. lucidulum* described by Spessard[10] (1920).

Further work on the germination of spores and on the other aspects of the plant is in progress.

Department of Botany, Royal Institute of Science, Mayo Road, Bombay-1, *March* 12, 1948.

T. S. MAHABALE.

1. Mahabalé, T. S. "Studies on the vascular cryptogams of the Bombay Presidency—Part I," *Journ. Bombay Univ.*, 1938, **6**, 69. 2. Chowdhury, N. P., "Notes on the anatomy of some species of the genus *Lycopodium* in India," *Trans. Nat. Insti. Sci.*, India, 1937, **1**, 189. 3. Mahabalé, T. S., and Deshpande, G. S., "*Psilotum triquetrum* Sw. at Lonawala," *Curr. Sci.*, 1942, **11**, 466. 4. Holloway, J. E., "Studies in the New Zealand species of the genus *Lycopodium*—Part I", 1915, **48**, 258. 5. A few of the plants and bulbils transferred to the Botanical Gardens of the Royal Institute of Science, Bombay, are doing fairly well till now. 6. Mahabalé, T. S. "On the discovery of the prothallus of *Lycopodium* in India," *Journ. Ind. Bot. Soc.*, 1937, **16**, 145-49. 7. Trueb, M., "Etudes sur les Lycopodiacées: II. Le prothalli du *Lycopodium Phlegmaria*," *Ann. du Jard. Bot. Buit.*, Java, 1886, **5**, 87-115. 8. Edgerley, K. E. "The prothalli of three New Zealand lycopods.," *Trans. N. Z. Insti.*, 1915, **47**, 94-111. 9. Holloway, J. E., Studies in the New Zealand species, of the genus *Lycopodium*, Part IV., *Trans. N. Z. Insti.*, 1920, **52**, 193-239. 10. Spessard, E. A. "The prothalli of *Lycopodium* in America," *Bot. Gaz.*, 1920, **63**, 66-76.

A NEW BACTERIAL DISEASE OF *MANGIFERA INDICA* L.

A bacterial disease of mango, observed on the Agricultural College Farm, Poona, and in the mango gardens at Dharwar in 1947, seems to be similar to that described from South Africa by Doidge.[1] Yet, the pathogen differs in several characters, to justify assigning it a specific rank.

On leaves, the pathogen produces a number of small, angular, water-soaked areas of varying dimensions ranging from 1 to 4 mm. in diameter. These, initially, light yellow, later turn deep brown with a clear halo around the necrotic spots The surface of such spots is often rough and raised due to drying of heavy bacterial exudation. The marginal infection of the leaves results in deformities and cracking. In most cases the spots crowd towards the tip of the leaves. The pathogen is able to infect the petioles, fruits and tender stems.

Pseudomonas mangiferae-indicae sp. nov.

Short rods, single or in chains of 2 to 4, 1·44-0·45 μ x 0·54-0·36 μ. motile, no endospore, non-capsulated, gram-negative.

On the potato dextrose agar, the colonies are circular, smooth, glistening, pulvinate, with entire margin, measuring 1 to 1·5 cm. in diameter after 7 days' growth; white to creamy white; no distinctive odour; gelatin liquefied; casein digested; starch attacked; hydrogen sulphide produced; litmus reduced; acid but no gas in dextrose, sucrose, lactose and mannitol; M. R. and V. P. test negative; no growth in Cohn's, but fair growth in Uschinsky's solution; no production of nitrite

indol and ammonia; optimum temperature for growth 27° C.; thermal death-point about 55° C.

Pathogenic on *Mangifera indica*, L. and *Anacardium occidentale*, L.

A detailed account of the disease is forthcoming.

Plant Pathological Laboratory,
College of Agriculture, Poona,
April 27, 1948.

M. K. PATEL.
L. MONIZ.
Y. S. KULKARNI.

1. Doidge, E. M., *Ann. Appl. Biol.*, 1915, **2**, 1.

A PRELIMINARY NOTE ON THE EYE OF *CENTROPAGES FURCATUS* DANA

WHILE the lateral eyes of Entomostraca like Copepoda are of interest because of their specialisation in the higher Crustacea and other Arthropods, the structure of the median-eyes on the other hand, excites interest because of its resemblance to that of the Nauplius. The rotatability of the median-eye has been recorded by Baird in *Diaptomous* castor and by Gerstæcker in *Dias* (Sub-order Calonoidea.) The enclosure of the eye in a special compartment of the body-cavity has been described in *Pontella helgolandica* by Gerstæcker (Pl. 7, Fig. 14). The composite nature of the median-eye is evident from the studies of *Corycæus, Sapphirina* (Dana), *Pontella, Dias* and *Temora* (Gerstæcker) belonging to the families *Corycæidæ* and *Pontellidæ* and *Calanidæ* by Dana and Gerstæcker. *Centropages furcatus* Dana, a Copepod belonging to the sub-order *Calanoidea*, occurring in the Madras Plankton has an eye capable of rotatory movements lodged in a compartment of the body-cavity and is composed of different units.

The eye is visible as a dark-red spot from the dorsal side and it consists of a bag-like structure with a pigmented quadrangular upper portion and a lower portion with a globular refractive-body lodged in it (Fig. 1, *rb.*) The diameter of the refractive-body is 0·16 mm. and it appears to be constant. Six retinula-cells can be made out in the pigmented-portion (Fig. *rc.*) each of which has a prominent nucleus towards its proximal margin. The cells are all coalescent, with a rhabdom (Fig. 1, *rh.*) in between the adjacent cell-walls towards the dorsal portion. The hypodermis (Fig. 1, *hy.*) appears as two-small thickenings below the cuticular-lens which covers the entire dorsal part of the eye. (Fig. 1, *cl.*)

The rotatability of the eye is due to three muscle-strands, two of which arise from the bases of the first antennæ and are thin (Figs. 1 & 2, *am.*) while the stouter third muscle arises from the posterior region of the cephalothorax (Figs. 1 & 2, *pm.*) and is attached to the middle of the pigmented portion (Fig. 2, *pm.*). These muscles rotate the eye to the right and to the left and dorsalwards. Di ap-

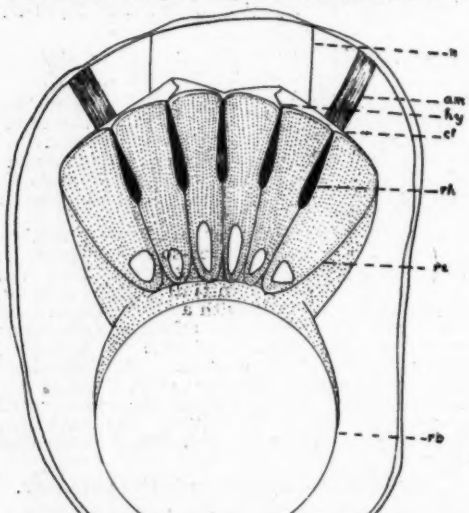


FIG. 1. Latero ventral view

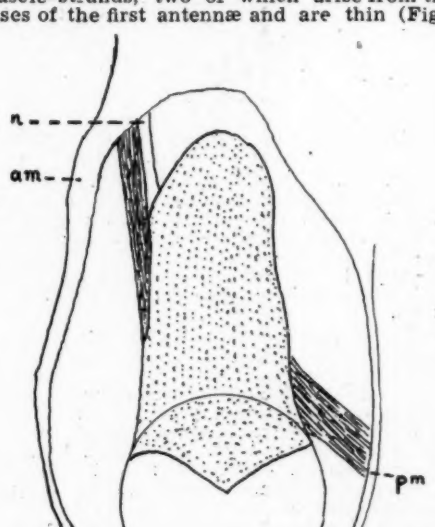


FIG. 2. Lateral view

am — anterior muscle; *pm* — posterior muscle; *hy* — hypoder mis; *cl* — corneal lens; *n* — nerve
rh — rhabdom; *rc* — retinula cell; *rb* — refractive body

tomous which has only twomuscles, the eye has been found capable of only left and right movements, whereas in Dias, which has four muscles, the eye can be rotated ventralwards as well (Gerstæcker, p. 650). The present form lacks this fourth muscle, and therefore, the capacity of rotating the eye ventralwards is lacking. There are two nerves running from the anterior side of the cephalothorax which supply the eye. When a very narrow pencil of light was projected near the creature, it was found, that the pigmented portion was always pointing towards the direction of light.

The eye is lodged in a papilliform projection of the cephalothorax on the ventral side. This corresponds to *P. helgolandica* (Gerstæcker). The cavity appears to be continuous with the body-cavity.

A brief survey of the median-eyes of copepods like *Pontella, Corycæus,* and *Dias,* as well as the lateral eyes of *Irenæus* and *Pontella,* suggests the wide range of adaptability of the visual organs. This is but one of the several specialisations which clearly show that the Copepods are by no means a simple basal group in the main line of evolution of higher Crustacea, but a highly evolved group with a number of different specialisations which, however, are not of phylogenetic value.

I am thankful to Dr. C. P. Gnanamuthu, M.A., D.SC., F.Z.S., Director, Zoology Laboratory, University of Madras, for translating some papers in German. I am also thankful to Mr. P. Vijayaraghavan, B.SC., for preparing the diagrams for publication.

Zoology Laboratory, S. KRISHNASWAMY.
University of Madras,
Chepauk, Madras,
May 19, 1948.

1. Baird, W., "The Natural History of British Entomostraca". Ray. Soc. London 1850. 2. Gerstaecker, Crustacea, Die Klassen und Ordnungen der Arthropden. 1866, p. 650.

ON THE BIONOMICS OF *CATLA CATLA* (C. AND V.) IN SOUTH INDIAN WATERS*

THE bionomics of *Catla catla* have been partly studied in Bengal[1]; this note gives observations on the species from South Indian waters.

Distribution.—Day[2] has not recorded this species south of river Kistna. After the introduction of the fish into the Kurnool-Cuddappah canal by the Madras Fisheries Department in 1909, it has migrated into the Pennar and other waters in Nellore District; and the fish was first recorded in the markets of Madras City in 1912.[3] Thanks to the intensive transplantation of the species into all waters in the province,[4] the fish now forms a major fishery in the Cauvery and has also been stocked in the neighbouring states of Cochin, Mysore and Travancore.

Food and feeding habits.—Catla is both a surface and a midwater feeder. Occasionally it browses along the marginal substratum to feed on molluscs. The observation of Thomas[5,6] that adult Catla feed on fish fry could not be corroborated. The composition, in percentage of volume, of the food of the species usually is (1) diatoms and desmids—25%, (2) crustaceans—25%, (3) vegetable matter—30%, (4) protozoa—7%, (5) polyzoans and rotifers—2%, (6) sand particles—3% and (7) other miscellaneous items—8%.

Breeding.—Catla attains maturity when 22 inches in size. The ripe ovarian egg measures 1·03 to 1·25 mm. in diameter. Spawning occurs in rivers from July to November. Breeding grounds are furnished by shallow rivers with submerged rocks or emergent vegetation, turbid water and a rapid flow.[7] The temperature of such environments ranges from 22 to 28° C.

Development.—The fertilised egg is spherical, 4·38 to 5·10 mm. in diameter, transparent, demersal and without oil globules. Segmentation commences about 40 minutes after fertilisation. The embryo becomes prominent after 10 hours, and measures 2·1 to 2·5 mm. in length. Pulsation of heart commences at 13th hour. Hatching occurs within 16 to 18 hours after fertilisation. The newly hatched larva is 4·38 to 5·25 mm. long, and is characterised by transparent body and conspicuous eyes, gillslits, pectoral fin-buds and median fin fold. The yolk-sac gets completely absorbed at the end of the second day. The larva measures 8 to 10 mm. in length, and possesses large head, red tinged operculum and anterior mouth. The caudal fin gets demarcated on the fifth day. Pigmentation of body commences on the sixth day. A size of 30 mm. is attained in five weeks, when the mouth gets turned upwards. Body becomes greenish-brown in colour, with golden tinges over the head region. The adult characters are completely assumed within another week.

Importance in rural pisciculture.—In Madras, the fish has grown to 29 inches and 9 lbs. in the first year of its life. In Madura and in the Willingdon Reservoir in South Arcot, a growth of 3½ to 4 feet and 30 to 50 lbs. within three years has been recorded. Owing to its non-predatory habit and rapid growth, Catla thrives in waters inhabited by other species with a rate of survival as high as 90%. The fish is thus best suited for culture in South Indian waters, the majority of which are non-perennial. The fry have been transported over long distances with a casuality of 3 to 8 per cent. The technique of collection, conditioning and transport of Catla fingerlings has been detailed by Jagannadham.[8]

Inland Fisheries Office, P. I. CHACKO.
8, Ormes Road, Kilpauk, G. K. KURIYAN.
Madras,
April 16, 1948.

* Communicated with the kind permission of the Director of Industries and Commerce, Madras.

1. Mukkerjee, H. K., *Sci. and Cul.*, 1945, **10**, 400. 2. Day, F., *Fauna of British India. Fishes*, London, 1889. 3. Raj, B. S., *Rec. Indian Mus.*, 1916, **12**, 249. 4. Hornell, J., *Adm. Rep. Mad. Fish. Dept.*, 1924, 12. 5. Thomas, H. S., *Tank Angling in India*, Madras, 1887. 6. —, *The Rod in India*, London, 1897. 7. Chacko, P. I., *Proc. 33rd Indian Sci. Cong.*, 1946, **3**, 128. 8. Jaganna tham, N., *J. Bom. Nat. Hist. Soc.*, 1947, **47**, 315.

REVIEWS

Network Analysis and Feedback Amplifier Design. By Hendrik W. Bode. (Published by D. Van Nostrand Company, New York, 1945), Pp. 551, Price 45 *sh.* net.

The book is primarily a treatise on general network theory. The omission of general transmission line and filter theory makes it a bit difficult of understanding for the beginner. But the first few chapters make it eminently suitable as a text-book for those who intend to study feedback problems from the design point of view.

The chapter on the design of Equalisers contains practically a summary of various methods and ideas of interest which serve as a good guidance on practical cases of equaliser design. To the best knowledge of the reviewer no text-book published hitherto covers so widely as the present book all the aspects of equaliser design.

The eighth chapter gives a sketch of the theory of analytic function in terms of integrals around closed contours which serves as a mathematical tool for transforming restrictions on the behaviour of network functions at complex frequencies into equivalent restrictions on their behaviour at real frequencies. The chapter also includes a discussion of Nyquist diagram method of determining stability.

The chapter on the graphical computation of relations between real and imaginary components of network functions consists mainly of a set of charts computed from somewhat complicated formulæ. These charts provide a ready method of computation of attenuation phase relation in practical cases. Methods for computing the charts have also been discussed.

The last two chapters on the design of single loop, absolutely stable amplifiers give a new approach to design procedure with illustrations. It may appear that the details of design have been carried out with too much of unnecessary refinement, but on a closer study, it would be evident that such details are not at all superfluous, when one considers the importance of feedback problems.

The discussion on feedback and non-feedback amplifiers with special reference to problems on transmission in wide band systems needs special mention.

The book can be strongly recommended as a reference, especially to those who are engaged in research and development work on feedback amplifiers, both narrow as well as wide band type.

S. K. C.

Industrial Electric Furnaces." Vol. II. By V. Paschkis; xiv + 320 pages with 293 figures. (Interscience Publishers, Inc., New York, 1948), Price $ 8·00.

Electric furnaces play a vital role in modern industry as they lend themselves to a wide variety of applications. Apart from the well-known electrometallurgical and electrochemical industries, electric furnaces are being increasingly used in other industries such as the ceramic, plywood, rubber and plastic industries. While the output of books on other branches of electrical engineering is large and steadily increasing, that on electric furnaces is surprisingly small. A book dealing with the modern developments in the science of electric furnace design and operation has been a long-felt want, and the book under review is therefore most welcome.

The subject-matter is covered in two volumes, the first volume (published in 1945) dealing mainly with Electrode Melting Furnaces (Arc type and Arc resistor type) and the present volume with Resistance Furnaces, Induction Furnaces and High Frequency Capacitance Furnaces. In addition the author draws a distinction between furnaces and heat appliances and a few of these are considered under each of the above categories.

The chapter on Resistance Furnaces and Appliances is divided into three sections—Indirect heat furnaces, Direct heat furnaces and Resistor type appliances. The section on Indirect Furnaces is again subdivided into radiation, convection and conduction furnaces and deals with some detail the design of furnace parts, temperature control, conveying mechanisms, resistors, both metallic and non-metallic, controlled atmospheres and other important features associated with these furnaces. The following types of furnaces are dealt with under this classification (*a*) Low temperature furnaces, used for infra-red heating, (*b*) Medium temperature furnaces with metallic resistors, used for hardening, carburizing, annealing, vitreous enamelling, etc., (*c*) High temperature furnaces with non-metallic resistors, used for hardening high speed steels, melting non-ferrous metals and glass, as well as firing ceramic materials, (*d*) Electrode salt bath furnaces, used for heat treatment and (*e*) Externally heated baths. Only a very brief mention, however, is made on the Direct-heat furnaces such as the Silicon carbide furnace. In the section on Heat Appliances an attempt has been made to analyze the basis of design and application of electrical heating in resistance welding devices, soldering irons, immersion heaters, drying machines used in laundries, heaters for cereals in grain elevators, etc.

Without in any way belittling the value of the book it might perhaps be pointed out that more emphasis on the application of "Kanthal" resistors would have been desirable. These resistors manufactured in Sweden are now being widely used in high temperature resistor furnaces for temperatures beyond the range of nichrome resistors (*viz.*, between 1150° C. and 1250° C.). Again while dealing with the subject of heat appliances a reference to electric boilers would have been very fitting. These have been mostly developed in Switzerland and several of them are reported to be in successful operation. The book leaves a general

impression that it reflects more of American practice rather than of European practice.

In the chapter on Induction and High-Frequency capacitance heating, emphasis is laid more on the thermal aspects and the relationship between electrical and thermal problems rather than the electrical fundamentals of induction and capacitance heating. Under induction furnaces both the core type and the coreless types of furnaces are described and questions of high frequency power supply, selection of frequency, design features, control equipment and special fields of application are also discussed. High frequency induction appliances are grouped into "surface heating" (such as hardening and brazing) and "through heat heating" (such as annealing and forging) jobs.

The next section deals with the main features of high frequency capacitance or dielectric heating and its applications to various industries such as the working of plastics and wood, drying of rayon cakes, dehydration of food, gluing of laminated glass, vulcanizing of rubber, drying of explosives, etc.

The book ends with a chapter devoted to a discussion on selection of furnaces.

Bearing in mind the immense scope of application of electric furnaces in industry, it would not be right to expect a book of this type to cover the whole field. Nevertheless, the author has made an admirable attempt to introduce a fairly rigid classification of furnaces to enable him to present the fundamentals of such design and operation. There is no doubt that the book would be a valuable guide to the furnace engineer using the furnaces, as well as the furnace designer and the power sales engineer. Numerous references to current literature given throughout the volume enhance its usefulness considerably. The printing and get-up are first rate. The riviewer was unable to find the price marked anywhere on the book.

H. N. RAMACHANDRA RAO.

Christian Huygens and The Development of Science in the Seventeenth Century. By A. E. Bell. (Edward Arnold & Co. London, 1947), Pp. 220. Price 18/- net.

This is one of the several biographical books published by Edward Arnold & Co., and furnishes an important link in the presentation of History of Science. Part I of the book records notable events in the life of Huygens. Part II deals with Huygens's scientific work and its relation to the state of science in the seventeenth century.

Christian Huygens came of a family which had already shown genius. His father, a man of outstanding ability and brilliance, completed a course of law, showed distinction in mathematical work, was a diplomat by profession and an amateur musician and painter. Huygens himself had interests ranging over a variety of subjects. He built his own telescopes, observed Saturn's rings amongst many other phenomena, made his own clocks and worked with several mechanical devices. He made notable contributions to several branches of science. Astronomy, dynamics and physical optics stand out prominently. He is to be regarded not only as a great thinker of his age but also as a scientific genius of all time. In his own world he was incomparable and "was one of the greatest ornaments of this time".

The book is an excellent exposition and contains a critical account of Huygens's scientific work. Huygens's contributions to physical optics, in particular his wave theory of light, are described in some detail in the book. The author has succeeded in presenting it in proper perspective in relation to the work of Huygens's contemporaries. For a student of the History of Science, it will be an invaluable acquisition.

S. BHAGAVANTAM.

The Differential Geometry of Ruled Surfaces. By Dr. Ram Behari, Lucknow University Studies, No. XVIII. Pp. 94.

This is a monograph dealing with certain particular aspects of the theory of Ruled Surfaces in three-dimensional space with regard to whose properties and the methods of derivation thereof, Dr. Ram Behari has made valuable contributions. The scope of the book is indicated by its principal contents, *viz*, properties of the line of striction, properties of generators, curved asymptotic lines, ruled surfaces of a rectilinear congruence, and deformation of ruled surfaces. Amongst the original contributions of the author, the most interesting in the reviewer's opinion, are his investigations on osculating quadrics, and on the pitch of a pencil of a rectilinear congruence. The bibliography given at the end will be valuable to workers in this field. The monograph should be in the hands of every one interested in this particular branch of geometry.

C. N. S.

The Identification of Trees and Shrubs. By F. K. Makins. (J. M. Dent & Sons Ltd., London), 1948. Third impression (Revised). Pp. vi+375. 2800 diagrams. Price 21*s*. net.

In books on plant systematics the method adopted for the identification of plants is based primarily on floral characters, supplemented by characters of other organs such as foliage, fruits, etc. The author of the book under review has, however, adopted a novel method for the identification of shrubs and trees of British Isles. In this the orthodox method is reversed, and identification is based in the first instance on foliar characters which is supplemented by floral and other characters. The advantage of this novel method lies in the fact that plants could be identified out of season when they are not in flower. With the aid of accurately drawn diagrams and the key provided, identification is made simple and easy. From the reference provided in the legends to the diagrams a description of the plant is obtained to complete its identification.

The book is written to serve the needs of professional gardeners, amateur plant collectors and others interested in plants. A special feature of the book is that technical terms are used to the minimum. The inclusion of a glossary of terms used has added to the value of the book. There are 2,800 diagrams which

are grouped according to the shape and arrangement of leaves. With the aid of these diagrams over 1,300 species belonging to 534 genera can be identified. A list of authors of botanical names and an index are provided.

The utility of the book can be judged from the fact that, first published in 1936 it has reached the third revised impression. Although the book restricts itself to shrubs and trees of the British Isles it could be of use to plant collectors outside Britain since a great majority of the trees and shrubs of the British Isles are introduced exotics.

L. S. S. K.

The British Aircraft Industry, 1948. (Society of British Aircraft Constructors Ltd., 32, Savile Row, London, W.1.), Pp. 279.

This is a directory of the members and associate members of the Society, giving particulars of the directorate, the principal manufacturing interests, production lines and specialities. The achievements of the firm, if any, during the world wars are briefly indicated.

The Directory is an extremely useful mine of information relating to the production of aircraft and its accessories. The volume will be welcomed not only by those who are directly interested in aircraft construction but also by research engineers and technologists seeking accessories and subassemblies for the construction of instruments and machines of their own design.

The text is given in all the three languages, English, French and Spanish, thereby extending the usefulness of the volume to practically every part of the Globe.

The Purums: an old Kuki Tribe of Manipur. By Tarak Chandra Das. (University of Calcutta), 1945. Price Rs. 10.

The volume under review is, according to the author, the outcome of five field trips during 1931-36 undertaken at the suggestion of the Political Agent of Manipur, Mr. J. C. Higgins. Much of the closely packed information that is presented in its pages was collected at interviews through the medium of Meithei interpreters. The way in which the routine of tribal life is observed and recorded is detached and objective.

The anthropometric measurements cover the entire adult male population. The Purums are short statured and mesocephalic with mesorrhive or leptorrhine noses and highly depressed nasions. They have medium lips and chins, coarse hair and their zygomatic arches are not at all prominent.

The Purums inhabit 4 small villages in Manipur State on the border of Burma, and the number according to the Census of 1931 is 303 (145+158). Their economic life is characterised by 'jhuming' which is supplemented by plough cultivation. The change from shifting agriculture to the use of the plough has entailed on the tribe certain far-reaching changes in its entire organisation and culture. One of the most prominent of such changes is the gradual decline of ultimogeniture which is giving way to an equal share of the property to all the sons.

Purums' social organisation is patriarchal, and the household is of the biological or the limited joint family type. Cross cousin marriage of one type, i.e., marriage with the mother's brother's daughter is enjoined while the opposite type of marriage with the father's sister's daughter is prohibited. Marriage is by service with the bride's family for three years, and no bride-price is paid. Widow remarriage is permitted, and usually takes the form of the levirate. Perum customs in relation to birth, puberty, marriage and death are essentially tribal, but show perceptible signs of Meithei or Manipuri influences. The dead are buried and ancestral spirits are venerated. Purum religion is largely Hinduized, and their pantheon includes, besides tribal gods, Rama, Krishna, Mahadeo and Kali. The Purums have four annual festivals each connected with a particular deity and characterized by dance, song and ritual. Shamanistic practices are equally prevalent and the office of the medicine-man is not hereditary but by initiation of the novitiate.

The Purum village is autonomous and governed by a council of village officers elected on a basis of merit and promoted according to seniority. Social rank is attained by giving prescribed feasts of merit. The village officers collect rent and settle disputes. With settled and peaceful conditions the offices have lost much of their power and dignity and are thrust on youngsters.

The Purums have a lunar calendar. They have no system of weights. Though musical instruments are used on all festive occasions, the artistic activities of the tribe find little scope or outlet.

Mr. Das has suggested a number of reforms in concluding his paper with an apotheosis of functionalism. Among such are improvements in the personal hygiene and rural sanitation of the tribe, the growing of a suitable variety of cotton as a cash-crop together with encouragement of spinning and weaving, the growing of fruit trees as a food crop, cattle rearing and the inclusion of milk in the tribal dietary, the provision of means for interesting the tribe in artistic activities and the rususciation of their now moribund ruishang or bachelor's hall as a nexus of social activities.

The get-up of the book and the photographic illustrations leave much to be desired. A number of genealogies are included in the book. The terms of address and marital relations are set forth in a number of tabular statements. A glossary and an index add to the usefulness of the volume. But the book is rather highly priced at Rs. 10/-.

C. H JAYADEV.

The Graphic Arts. By William H. Johnson and Louis V. Newkirk. (Publishers : The Macmillan Company, New York and London), 1942. Pp. i-vii plus 1-160. Price 14s. net.

In the foreword to the book, the authors have written : "This volume, one of a series on industrial arts education, is a pupil text intended to introduce youth to the field of the graphic arts." This idea they have kept well in mind in dealing with the subject throughout the book. Without going too much into technical details, the book introduces the reader to the several processes involved in producing a book.

In Chapter I the authors say: "The divisions of the graphic arts industry are printing, etching and engraving, photography, bookbinding and drawing." In the subsequent chapters these subjects are dealt with so as to give the reader a general idea as to how these are carried out.

The first chapter is introductory dealing on the subject in a general way and gives a brief history of the development of printing.

The next four chapters deal with the production of print from type. The manufacture of type is briefly explained. The methods of setting type by hand and by machines are described. The various kinds of printing machines, from the hand press producing a few hundred copies an hour to the rotary machine producing 50,000 copies an hour and the purpose for which each is best suited are explained.

Chapters VI to VIII are devoted to the printing of illustrations. The different kinds of blocks and how they are prepared and printed are described in these chapters. The preparation of linoleum engravings and their use is dealt with in detail, a separate chapter being devoted to it.

The subject of lithography is disposed of in four short paragraphs. It would have added to the usefulness of the book if this subject was dealt with more fully.

Silk-screen printing is the subject of Chapter IX. Though linoleum engraving and silk-screen printing are simple and cheap methods of producing illustrations, these have not found favour with printers in India, either because these methods are not commonly known or because printers do not wish to be bothered with them when line and halftone blocks are easily available at cheap prices.

Chapter X deals with estimating and cutting paper stock. Some reference is made to estimating. This is an important subject and the authors might have devoted a separate chapter and gone into the subject in some detail.

Chapter XI describes several kinds of duplicating machines and their working.

The next two chapters take the reader through the bindery and explain fully how the binding of books of different kinds is carried out.

Paper making is the subject of the next chapter. Here is described the making of handmade and machinemade papers. The simple tests given for testing paper without elaborate laboratory equipment, ought to be of great help to people who buy paper in large quantities.

Photography which is a subject closely connected with printing is the subject of the last two chapters.

At the end of each chapter is given a set of questions on the subject dealt with in the chapter. This will be of great use to the student. The bibliography at the end of each chapter will be of use to readers who want more information on the subjects dealt with in the several chapters. A useful index is given at the end of the book.

The book is profusely illustrated. The illustrations are of great help to the reader in understanding the text.

The book is written in simple language without the use of many technical terms. As a book to introduce the pupil to the graphic arts, it is eminently suited. B.S.I.

Science News 6. Penguin Books. Pp. 144, 1948, price 1*sh.* net.

Vol. 6 of Science News contains a miscellany of articles on recent developments in the field of physics, agriculture, biology, medicine and glaciology, presented in such a manner as to be comprehensible to the layman and of interest to the scientist wishing to keep up with current scientific research other than in his own field of specialisation. Of particular is, "Report on Antarctica" in view of the recent political interest in the south polar regions.

V. B.

SCIENCE NOTES AND NEWS

Dr. C. S. Pitchamuthu and Mr. B. Rama Rao, Department of Geology, Mysore

Dr. C. S. Pitchamuthu, Superintendent, Intermediate College, is appointed as Director of Geology in Mysore. His original contributions to geological science are well known to readers of *Current Science*. He was elected President of the Section of Geology at the Delhi Session of the Indian Science Congress in 1947. We are confident that, during his regime the Department of Geology, which has always enjoyed, thanks to a succession of distinguished Directors, the reputation of being one of the progressive scientific departments in India, will make even greater advances in scientific and technological fields of geology and contribute towards the wealth and prosperity of the State.

Mr. B. Rama Rao, who has been granted leave preparatory to retirement has been entirely responsible for initiating many schemes pertaining to the exploitation of the mineral wealth of the State. The discovery and working of the Bellara Gold Mines is due to his vision and enterprise. Mr. Rama Rao leaves to his successor Dr. Pitchamuthu, an inspiring tradition, an efficiently organised and well equipped department, and a ten-year programme of development.

Dr. A. L. Narayan

Dr. A. L. Narayan, till recently Director of the Kodaikanal Observatory, has been appointed Principal of the Maharaja's College, Vizianagram. He was connected with this institution as Professor of Physics and Director of Research Laboratory during 1914-18.

Indian Dairy Science Association

The first General Body Meeting of the Indian Dairy Science Association was held on the 15th May 1948 at 5 p.m. at the premises of the Indian Dairy Research Institute, Bangalore, with Sir Datar Singh, Vice-Chairman, Indian Council of Agricultural Research, in the chair. A distinguished gathering of local scientists, members of the Association and students of the Indian Dairy Research Institute participated in the proceedings.

The General Body ratified the Constitution and Rules of the Association and also elected the office-bearers and members of the Executive and Editorial Committees. Sir Datar Singh was elected as the Hony. President of the Association.

In the course of his presidential address Sir Datar Singh pointed out that this Association fulfilled an urgent and long felt need for an organisation which could co-ordinate and unify the activities of the dairy scientists of the country towards one common purpose, namely the rapid advancement of the nation's dairy industry. Dairying held a very important position in the Agricultural economy and prosperity of the country, and for quite a long time—they had been acutely conscious of the necessity for not only increased producion of milk but also improvement of its quality, its marketable life and its economic utilization in subsidiary food industries. If these problems were to be tackled successfully, intensive research work was called for on the best method of preservation of milk, production of clean milk, better handling and marketing of milk and milk products, etc.

The first issue of the Indian Journal of Dairy Science is expected to come out shortly.

Sugar Research Foundation, Third Annual Award

For research that promises to develop common sugar as a key raw material of industry, Dr. Leslie F. Wiggins, of the University of Birmingham, England, was awarded the Third Annual Sugar Research Prize of $5,000. At a dinner held at the Hotel Biltmore, Dr. Vincent du Vigneaud, Professor of Bio-Chemistry, Cornell University Medical College, presented the prize in behalf of the National Science Fund, which administers the award program. Dr. Robert C. Hockett, Scientific Director of the Foundation, described the work of Dr. Wiggins as "a milestone in the advance toward better use of cheap and abundant plant products to serve the myriad needs of civilization.

"With the depletion of coal and petroleum reserves," he said, "greater dependence must be put on utilising the continuing supply of material produced by growing plants. Among these abundant materials sugar is undergoing careful study because chemists have learned how to produce vast quantities at low cost."

The first Sugar Research Foundation Prize was shared by Drs. W. Z. Hassid, H. A. Barker, and Michael Duodoroff for the first synthesis of sugar which has made possible "tracer" studies of the metabolism of sugar in the human body. Dr. Carl F. Cori, recent Nobel Prize winner, received the second annual award last April for his contributions to the knowledge of how the body uses starches and sugars.

Flying Display and Exhibition in September, 1948

The Society of British Aircraft Constructors, 32, Savile Row, London, W. 1, will hold its 9th Flying Display and Exhibition in September this year. The capabilities of the latest British civil and military aircraft and engines will be demonstrated in flight, and presented for inspection on the ground.

In addition to the Flying Display, a Static Exhibition on the aerodrome of aircraft engines, aircraft accessories, materials and parts, will show the latest developments in British aeronautical equipment, and will provide a complete survey of the products of the Aircraft and associated Industries.

Andhra University

The M.Sc. Degree in Mathematical Physics of the Andhra University has been awarded to the following research scholars :—

1. K. Subramanya Sarma, 2. S. Krishna Kutty Nair.

Delhi University

Dr. M. L. Bhatia, Ph.D., D.Sc., Reader in Zoology, University of Lucknow, has been appointed Reader and Head of the Department of Zoology, which has been started this year in the Delhi University. Dr. Bhatia's special subject is general morphology with particular reference to *hirudinea*.

Mr. L. N. Johri, M.Sc., formerly of Rangoon University and till lately Research Assistant to Professor K. N. Bhal of Lucknow University, has been appointed Lecturer in Zoology, Delhi University.

Lady Tata Memorial Trust Scholarships and Grants for the Year 1948-1949

The Trustees of the Lady Tata Memorial Trust announce on the 18th June 1948, the death anniversary of Lady Meherbai Dorabji Tata, awards of scholarships and grants for the year 1948-1949.

The International awards for research in diseases of the blood with special reference to Leucæmias are made to Dr. & Mrs. Paterson (England), Doctors, Peter A. Gorer (England), Edith Paterson (England), Jorgen Bichel (Denmark), Pierre Cazal (France), Johannes Clemmesen (Denmark), Guido Totterman (Finland), C. P. M. Plum (Denmark), M. C. Bessis (France), Simon Iversen (Denmark), A. Kelemen (Hungary) and Prof. Edoardo Storti (Italy).

Indian Scholarships of Rs. 250/— per month each one year for scientific investigations having a bearing on the alleviation of human suffering are awarded to Miss V. Shanta Iyengar (Bombay), Messrs. Suprabhat Mukerjee (Calcutta), Yashwant Balkrishna Rangnekar (Bangalore), Gangagobinda Bhattacharya (Calcutta), K. Ramamurti (Bangalore), and B. K. Sur (Bangalore).

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Indian Association for the Cultivation of Science

210, BOWBAZAR STREET, CALCUTTA-12

Applications are invited for the posts of: (1-2) a Professor of Organic Chemistry and a Professor of Theoretical Physics, in the grade of Rs. 800-40-1,000; 1,000-50-1,250;

(3-4) a Research Officer in Physical Chemistry and a Research Officer in Optics, in the grade of Rs. 300-25-500. D. A. and Provident Fund in all cases.

Applicants for Professorship should be distinguished scientists having long experience of research, and will be required to organize and promote research and guide scholars in research work in their respective subjects. Experience of work on high polymers is desirable.

Research Officers will have to carry out and organize research under the guidance of Professors. Applicants should ordinarily have a Doctorate Degree with long experience of research work in: Optics including Light-scattering & Raman Effect for (3) and Physical Chemistry preferably Chemistry of High Polymers for (4).

Six copies of applications together with testimonials, statement of qualifications and age, and copies of original publications, should reach the Registrar on or before Aug. 1, 1948.

For candidates applying from overseas, abstracts of applications may be sent in advance by Air Mail.

INDIAN INSTITUTE OF SCIENCE
BANGALORE 3

With reference to the advertisement dated 20-4-1948, issued by the Indian Institute of Science, inviting applications for the post of Professor and Head of the Department of Aeronautical Engineering at the Institute, it is hereby notified that as the advertisement has since been withdrawn, candidates are advised that they need not apply for the post.

A. G. PAI
Registrar

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